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AIDS

TO

BOTANY.

BY

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AIDS
TO
BOTANY.

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PREFACE.

In preparing this, the Second Edition of "Aids to Botany," the work has been almost entirely rewritten, and considerably extended by the addition of a large amount of new matter.

It will be readily understood that the subject is a difficult one to deal with without the assistance of illustrations, the employment of which, in the limited space allotted to the "Aids Series," has been impossible.

The endeavour has been to place before the student all the leading facts of the science in the plainest language possible, the hope throughout having been to render the present volume still more deserving of the favour with which its predecessor has been received.

ARMAND SEMPLE.

8, Torrington Square, W.C.
May, 1883.

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Liliaceæ Melanthaceæ	Petaloideous Endogens.
Graminaceæ	=Glumiferous Endogens.
Filices	=Acrogens.

AIDS TO BOTANY.

I.—THE SEED.

A SEED, when placed in the ground under favourable circumstances, begins to swell and forms a protrusion which can be divided into two parts:—

1. The **Plumule or Gemmule**, which grows upward to the light, and becomes the stem.
2. The **Radicle**, which sinks into the earth, and grows downwards.

The **Tigellus**, or collar, is the point at which these two parts are joined together, and possesses one, two, or more lateral organs called the **Cotyledons.**

II.—THE ROOT.

"The descending axis of the plant, usually penetrating the ground, fixing the plant and absorbing nourishment already in a fluid state."

When roots are developed from the radicle, they are termed **Axial** or **True roots.** All roots that are otherwise developed are called **Adventitious.**

Axial roots are only found in the *Dicotyledons*, or plants having two seed-lobes; the adventitious occur in *Monocotyledons*, or those with one seed-lobe; but since *they may* be developed from various parts, and even from the leaves, they may be found upon dicotyledonous plants.

Axial roots are :—

1. The **Tap-root**, Fusiform, or spindle-shaped root; in which one central part is more prominent than the rest, and appears like a continuation of the stem.
   Example, the Carrot.
2. The **Fibrous-root**; in which the branches of the radicle are numerous and nearly of the same size. Examples, Lilies and onions.
3. The **Napiform**, or turnip-shaped, as the Turnip.

Adventitious roots are :—

1. The **Tuberous**, corresponding to the tap-roots of the carrot; produced by thickening of some of the branches. Example, the Dahlia.
2. **Fasciculate**; a mixture of the tuberous and fibrous. Example, Ranunculus ficaria.
3. **Moniliform**, like a necklace; with alternate contractions and expansions, the swellings being a little apart.
4. **Annular**; the swellings close together.
   Example, Ipecacuanha.
5. The **Nodose** or **Nodulose**; the swellings at irregular intervals.
   Example, Spiræa filipendula.
6. **Contorted**; when a tap-root is twisted instead of being straight.
7. **Præmorse**, or bitten off; when the root ends abruptly.
8. The **Double fusiform tap-root**, thickest in the middle. Example, the Radish.
9. *The **Coralline**-root*, like Coral.
   Example, the orchid Corallorhiza.

Aerial roots are those which are developed in the air from the air, and since they usually grow upon other plants, although from them, they derive no nourishment, are termed **Epiphytes**. They are observed in the mangrove, in which they are axial, and in the ivy, in which they are adventitious.

Aquatic roots are seen in the water ranunculus, in which they pierce the soil, and in the duckweed, in which they are floating. These roots closely resemble rhizomes, only they do not produce leaves or buds. The extremities of roots terminate in **Spongioles**, or loose cellular layers.

THE OFFICINAL ROOTS.

Aconitum. Aconitum Napellus. Aconite.
Armoracia. Cochlearia Armoracia. Horseradish.
Arnica. Arnica Montana.
Belladonna. Atropa Belladonna.
Calumba. Jateorrhiza Calumba. Cocculus Palmatus.
Gentiana. Gentiana Lutea. Gentian.
Glycyrrhiza. Glycyrrhiza Glabra. Liquorice.
Granatum. Punica Granatum. Pomegranate.
Hemidesmus. Hemidesmus Indicus.
Ipecacuanha. Cephaëlis Ipecacuanha. Ipecacuan.
Jalapa. Exogonium Purga. Jalap.
Krameria. Krameria Triandra. Rhatany.
Pareira. Cissampelos Pareira.
Pyrethrum. Anacyclus Pyrethrum. Pellitory.
Rheum. Rheum Officinale. Rhubarb.
Sarsa. Smilax Officinalis. Sarsaparilla.
Sassafras. Sassafras Officinale.
Scammonium. Convolvulus Scammonia. Scammony.
Senega. Polygala Senega.
Serpentaria. Aristolochia Serpentaria. Serpentary.
Sumbul. Euryangium Sumbul.
Taraxacum. Taraxacum Dens Leonis. Dandelion.
Valeriana. Valeriana Officinalis. Valerian.

III.—THE STEM.

"The developed plumule."

The **Bud** which terminates the plumule is called the **Terminal bud.**

Axillary buds are those which originate in the angles between the leaves and stem.

A **Node** is the part of the stem at which the leaf originates.

An **Internode** is the space between any two nodes.

Bracts are modified leaves.

Stems are divided into **Underground** and **Aërial:** the former have leaf-scales (appendages at the lower part of the stem where it is covered by the earth); the latter have leaves and bracts.

Underground stems comprise the following :—

1. The **Bulb**, chiefly composed of leaf-scales.
    - (*a*) *Tunicated,* when entirely encircled by scales. Examples, Onion and Hyacinth.
    - (*b*) *Squamous* or *Scaly*, when partially surrounded. Example, Lily.

    Officinal Bulb, Urginea Scilla.
2. The **Corm** (a solid body), formed of a thickened stem with the internodes only slightly developed, and a small bud surmounting the whole. Example, Crocus.

    Officinal corm, Colchicum Autumnale.
3. The **Rhizome** or **Rootstock**; which is capable of producing leaf-buds, and has the internodes little developed.
4. The **Tuber**; this may be the base of the stem, or a part of a branch from the axil of a leaf-scale much thickened. It possesses buds in the form of eyes which are able to produce independent stems. Example, Potato.

    Officinal Tuber, Jalap.

Aerial stems are Herbaceous and Woody; when they stand upright they are termed **Erect**; when they assume other positions they receive the name of **Procumbent, Decumbent, Ascending**, or **Creeping.**

Some plants are distinguished as (*a*) *Climbing*, either by tendrils (the Pea); by adventitious roots (the Ivy); or by leaf-stalks (the Clematis); and (*b*) *Twining*, by twisting round supports (French Bean and Hop).

Woody stems are observed only in plants which are destined for a somewhat prolonged existence. They are divided into **trunks** and **stocks**, according to their mode of branching.

If the stem gives off branches at various elevations, it is termed a **Trunk** or **Truncus**; but if these leaves and branches are confined to the summit, it is termed a **Stock** or **Caudex.**

The latter is shown in the palms, the former in most of the forest trees.

The stem of grasses is called a **Culmus**, and that of most herbaceous plants a **Caulis.**

THE OFFICINAL RHIZOMES.

Curcuma.	Curcuma Longa.	Turmeric.
Filix.	Filix Mas.	The Male Fern.
Podophyllum.	Podophyllum Peltatum.	
Zingiber.	Zingiber Officinale.	Ginger.

THE OFFICINAL STEMS, &c., ENTIRE PLANT.

Chirata.	Ophelia Chirata.	Chiretta.
Lactuca.	Lactuca Virosa.	Lettuce.
Lobelia.	Lobelia Inflata.	

THE OFFICINAL BARKS.

Canella.	Canella Alba.
Cascarilla.	Croton Eleuteria.

Cinchona. { Cinchona Flava. Yellow.
Cinchona Pallida. Pale.
Cinchona Rubra. Red. }
Cinnamomum. Cinnamomum Zeylanicum. Cinnamon.
Cusparia. Galipea Cusparia. Angustura Bark-tree.
Mezereum. Daphne Mezereum. Mezereon.
Nectandra. Nectandra Rodiæi. Bebeeru-tree.
Quercus. Quercus Pedunculata. Oak.
Ulmus. Ulmus Campestris. Elm.

OFFICINAL WOODS.

Catechu. Acacia Catechu.
Dulcamara. Solanum Dulcamara.
Guaiacum. Guaiacum Officinale.
Hæmatoxylum. Hæmatoxylum Campechianum. Logwood.
Pterocarpus. Pterocarpus Santolinus. Red Sandalwood.
Quassia. Picræna Excelsa.

OFFICINAL TOPS.

Aconitum. Aconitum Napellus. Aconite.
Cannabis Indica. Cannabis Sativa. Indian Hemp.
Conium. Conium Maculatum. Hemlock.
Hyoscyamus. Hyoscyamus Niger. Henbane.
Sabina. Juniperus Sabina. Savin.
Scoparius. Sarothamnus Scoparius. Broom.

PECULIAR.

Galla. Quercus Infectoria. Galls.

IV.—THE LEAF.

"The typical appendage of the stem."

Leaves are called **Alternate** when no two of them are upon the same level; **Opposite** when two or more originate upon each node, and **Verticillate** or **Whorled** when more than two originate from each node, the whole collection of leaves being termed a **Whorl** or **Verticillus.**

In the perfect leaf are these parts :—

1. The **Vagina** or **Sheath**; the portion of the leaf at its insertion surrounding the stem either partially or entirely.
2. The **Petiole** or **Foot Stalk**; the continuation of the sheath.
3. The **Lamina** or **Blade**; the flattened portion.

To these, in some cases, membranous expansions or **Stipules** are added.

The point at which the leaf joins the stem is called its **Insertion**, the connexion being by a joint or direct. A jointed leaf, when it falls, breaks off at the joint. When the joint is absent the leaf withers, and leaves a ragged **scar** called **Cicatrix**, the swelling below being termed the **Pulvinus** or **Cushion.**

A **Phyllode** is the term used when the petiole becomes enveloped in a leaf-like manner, the lamina being abortive or nearly so.

A leaf is termed **Sessile** when its development is arrested after the formation of the blade, but before the appearance of the petiole. When the petiole is present the leaf is called **Petiolate.**

A **Simple** leaf is that in which there is only one joint, situated at the stem; **Compound** when the leaf consists of several joints, or of which the petiole bears more than one distinct blade.

The skeleton of a leaf consists of *subdivisions* of the petiole, the larger constituting the ribs, the smaller the veins. The plan on which they are arranged is termed **Venation.** Should the petiole be continued into the blade it is termed the **Midrib.**

In Endogenous plants the small veins cross at right angles; the larger veins are parallel and straight.

In Exogenous plants the small divisions cross at an angle; and the larger not being straight, a nettled or reticulated appearance is presented.

A leaf is termed **Oblique** when the portion on one side of the midrib is larger than that on the opposite side.

When the portions of the blade are carried backwards like a pair of ears the term **Auriculate** is applied.

When the stem is embraced by the leaf it is called **Amplexicaul.**

If the two ears pass back and unite upon the other side of the stem, the leaf is said to be **Perfoliate,** the stem appearing to pass through the leaf; if two leaves are opposite and their bases unite, they are termed **Connate.**

When the ears of petiolate leaves are prolonged far enough back to unite, the form is called **Peltate.**

When the apex of a leaf terminates in a sharp point it is termed **Acute**; when the point is very sharp, **Acuminate**; when very sharp and hard, **Cuspidate.** A blunt-ended leaf producing a short sharp point is called **Mucronate.** When the apex ends in a blunt extremity it is called **Obtuse**; when there is a slight hollow, **Emarginate**; when the hollow is large and shallow, **Retuse.**

A leaf is termed **Entire** when the margin presents *no* indentations; **Crenate** when it possesses slight *rounded projections*; **Dentate** with deep and sharp *projections*; ***Serrate*** when the sharp points look towards the apex; **Retroserrate** when they look towards the base.

Other forms of leaves are **Orbicular** or round, **Sub-rotund** (roundish), **Oval, Oblong, Linear** (long and narrow, same width throughout), **Acicular** (needle-shaped), **Cordate** or heart-shaped, **Lanceolate** (like a lance-head), **Reniform** (like a kidney), **Subulate** (like an awl), **Ovate** (egg-shaped), **Spathulate** (spoon-shaped), **Oblanceolate, Obovate** (reversely ovate), **Obcordate** (reversely heart-shaped), **Sagittate** (like an arrow), **Panduriform** (bent in the middle, somewhat like a fiddle), **Hastate** (halberd-shaped), **Palmate** (with five lobes resembling a hand).

Sometimes a leaf is divided by its indentations into two or more lobes, and it is then named according to its nervation. Thus, amongst feather-veined leaves a leaf is **Pinnatifid**, in which the incisions are superficial, and correspond with the intervenous spaces; **Pinnatisect** when the incisions are deeper; **Pinnatipartite** when they almost reach the midrib.

Palmate leaves are similarly called **Palmifid, Palmisect**, and **Palmipartite. A Pedate** leaf is that in which there is an unusual amount of ribs, the lower being turned backwards to the petiole.

Compound leaves are divided into the **Pinnate** (like a feather), and **Palmate** or **Digitate** (like a hand). When the number of leaflets on the side of the rachis are even the leaf is called **Paripinnate**; with a terminal leaflet, **Imparipinnate.**

Leaves are termed *membranous*, *fleshy*, *leathery*, according to their consistence.

Deciduous is the name applied when the leaf falls in autumn.

Persistent when it lasts beyond the winter.

The surface of leaves may be smooth (glabrous), hairy *(pilose)*, *rough* (scabrous); with stiff hairs (hispid), bristly *(setose)*, with *glandular* hairs (viscous), etc.

THE STIPULE

Is a small membranous expansion on either side of the point where the leaf joins the stem. When stipules are absent the leaf is called **Exstipulate**; when present, **Stipulate.** These stipules are considered by some to be *partially developed leaves,* by others to be *portions of the leaf-sheath peculiarly developed.*

In the normal condition are found the **Free** or **Caulinary** stipules, viz.: two free lateral expansions at the base of the leaf.

Adnate stipules are those which adhere to the petiole. **Connate** are those which unite one with the other.

There are three kinds of stipules:—

1. **Axillary** or **Intrafoliaceous**; two stipules uniting to form a single organ in the leaf axil, and situated between the leaf and stem.
2. **Intrapetiolar**; when the stipules are upon the side of the stem opposite to the leaves.
3. **Interpetiolar,** simulating whorled leaves.

An **Ochrea** is the sheath formed by conjoined stipules which are sufficiently large to surround the whole stem.

A **Ligule** is a little membranous organ found in grasses which occurs in the axil of every leaf, and is said to be constituted of axillary stipules.

A **Phyllode** is the name applied to a petiole which becomes flattened and assumes the functions of a leaf whose lamina has fallen off.

A **Tendril** is a modification of a leaf, and is the thread-like process by which plants attach themselves to other objects.

Thorns are formed by some modified portion of a leaf.

Prickles are hardened hairs, and are only attached to the epidermis.

Setæ are bristles or stiff hairs.

OFFICINAL LEAVES.

Aconitum Napellus. Aconite.
Aloe Vulgaris.
Belladonna. Atropa Belladonna.
Buchu. Barosma. { Betulina. Crenulata. Serratifolia. } Bucco.
Conium Maculatum. Hemlock.
Digitalis Purpurea. Foxglove.
Hyoscyamus Niger. Henbane.
Laurocerasus. Prunus Laurocerasus. Cherry Laurel.
Matica. Artanthe Elongata. Matico.
Melaleuca Minor. Cajuput.
Senna. { Alexandrina. Cassia Lanceolata and Obovata.
Indica. Cassia Elongata.
Stramonium. Datura Stramonium. Thorn Apple
Tabacum. Nicotiana Tabacum. Tobacco.
Uncaria Gambir. Catechu Pallidum.
Uva Ursi. Artostaphylos Uva Ursi. Bearberry.

V.—BUDS.

These are divided into **leaf-buds** (for the repetition of the individual) and **flower-buds** (for the reproduction of the species), both being composed of rudimentary leaves.

They are frequently protected by **Scales** (**Bud-Scales** or Tegmenta), and sometimes by hairs; when these are absent the bud is called **Naked.**

Vernation or **Præfoliation** is the name given to the arrangement of the leaves in the leaf-bud; that of the flower-bud is called **Æstivation** or **Præfloration.**

When a leaf is so folded that the apex is applied to the base it is termed **Reclinate,** as in the Tulip-tree; when the two edges are in contact, the midrib being in the *centre, it* is called **Conduplicate.** A leaf may be rolled up from the apex to the base, and is then called **Circinate**, as in ferns; or from side to side, **Convolute**, as in the cherry.

If the rolling commences simultaneously at both sides it is called **Involute**, as in the buds of the water-lily; if towards the back of the leaf, **Revolute**, as in the lavender. When there is a plaiting of the lateral halves of the leaf the term **Plicate** is given, as in the currant and vine.

Leaves are termed **Imbricate** which overlap each other, three being partly within and partly without, one entirely without the others, and one entirely within.

When the edges of the leaves touch each other, but do not overlap, they are called **Valvate**. If the edges in juxtaposition are turned inwards, the variety is known as **Induplicate**.

VI.—THE INFLORESCENCE.

The flower-bud when developed produces flowers which are variously arranged upon their axis. This arrangement is termed the *Inflorescence*, and is either **Terminal** or **Axillary**.

The axis which supports the flower is termed the **Peduncle** or Flower-stalk, and this receives the name of **Rachis** when it gives off secondary branches, or **Pedicels**, the leaves at their bases being termed **Bracteoles** or Bractlets.

Some plants with their stems underground send up naked stalks, surmounted by one or more flowers, as in the primrose and cowslip. These stalks are termed **Scapes**.

Bracts *are modifications* of the flower-bud. These *re sometimes almost* indistinguishable from true leaves. They are sometimes modified to such an extent as to appear like the flower itself.

A whorl of bracts is called an **Involucrum**, secondary whorls being termed **Involucels.**

Phyllaries are individual bracts occurring in the order *Compositæ.* A **cupule**, the cup of the acorn, is composed of bracts; and the outer whorl of grasses is composed of bracts called **Glumes.** In the order *Rosaceæ* there is often an apicalyx composed entirely of bracts. Little bracts, called **Paleæ**, are found at the base of each of the small flowers constituting a daisy.

A large coloured bract enclosing the inflorescence, as in the Trumpet Lily, is called a **Spathe.**

The inflorescence is said to be **Definite** or **Centrifugal** (flying from the centre), and **Indefinite** or **Centripetal** (seeking the centre), according to the character of the terminal bud.

The former term is employed when a flower-bud terminates the axis; the latter term, when a leaf-bud is similarly situated.

Amongst **Indefinite Inflorescences** are :—

1. The **Raceme**; here, along the axis or axes, stalked flowers arise, the stalks being of nearly equal length. Example, Currant.
2. The **Panicle**; when the rachis gives off branches supporting several flowers. Example, Oak.
3. The **Thyrsus**; the flower short and thick, the whole inflorescence appearing pyramidal. Example, Horsechestnut.
4. The **Corymb**; all the flowers about the same level through elongation of the lower pedicles of the raceme.

   Example, Cauliflower as eaten.
5. The **Umbel**; the origin of all the flower-stalks

upon the same level, like the spokes of an umbrella. Example, Hemlock.

When the peduncles thus originating branch again in the same manner, the secondary umbels are termed **umbellules.**

6. The **Spike** may be termed a raceme with no flower-stalks. Example, Common Plantain.
7. The **Spadix,** a spike whose axis is fleshy and surrounded by a spathe. Example, Arum.
8. The **Amentum** or **Catkin**; the axis of unisexual flowers, and falling early. Example, Willow.
9. The **Cone** is a modification of the spike, with *woody* bracts. Example, Pine.
10. The **Strobile** is the same as the cone, with *membranaceous* bracts. Example, Hop.
11. The **Locusta** is a form of spike occurring among grasses.
12. A **Capitulum** is when the axis of the spike presents a flattened plane, as in the Compositæ. The florets may be indistinguishable, or they may be divided into those of the disc and those of the ray. Example, Daisy.

The capitulum bears the same relation to the spike as the umbel to the corymb or raceme.

The **Definite Inflorescence**

Is characterised by the flower-bud being developed before any other on the same axis.

Under this heading is :—

The **Cyme,** which may simulate any of the indefinite forms, especially the corymb, panicle, and raceme. It is subdivided into :—

(*a*) The **Cœnanthium** ; a sessile cyme with a definite capitulum of suppressed inter*nodes.* Example, Fig.

(*b*) The **Fasciculus**; a contracted cyme.
Example, Sweetwilliam.

(*c*) The **Glomerulus**; a very condensed cyme.
When the last two, (*b*) and (*c*), are arranged in the axils of opposite leaves so as to resemble whorls, they are termed false whorls or **Verticillasters.**

(*d*) The **Uniparous** cyme; where the flowers arise only upon one side of the axis. Example, Hyoscyamus.

(*x*) **Helicoid,** when the axis is evidently interrupted.

(*y*) **Scorpioid,** when the axis appears continuous.

(*e*) The **Biparous** cyme; flowers arising on both sides of the axis.
Example, many of the Caryophyllaceæ.

Anomalous Inflorescence.

Some forms of inflorescence cannot be easily assigned to any of the foregoing types. In Ruscus or the Butcher's broom, and in Tilia, the Lime-tree, the flowers seem to arise from the centre of the blade of the leaf.

In the Butcher's broom, the part resembling a leaf is in reality a flattened branch, from which is developed the flower-bud in the axil of a small membranaceous bract.

In the Lime, the peduncle is adherent to the petiole of its subtending bract, until it reaches the centre of the leaf, at which it becomes erect.

An Inflorescence when it falls early is termed **Caducous**; when it falls at the ripening of the fruit, **Deciduous**; when it remains attached to the ripe fruit, it is **Persistent**; when the peduncle becomes enlarged and fleshy it is termed **Excrescent.**

VII.—THE FLOWER.

> "Consists of a number of whorls of leaves (usually four) modified for the reproduction of the species, and situated at the extremity of an axis, of which the internodes at that point are but slightly, if at all, developed."

The top of the flower-stalk is termed the **Receptacle, Thalamus**, or **Torus.** The outermost of the rows of the whorl constitute the **Calyx** or **Sepals**; the next constitute the **Corolla** or **Petals**, and these two form the *non-essential organs* of reproduction; but within these are two other whorls, one of the male, the **Stamens (Andræcium)**, the other of the female, the **pistils (Gynæcium)**, constituting the *essential organs.*

The **Dicotyledonous** type usually presents five sepals, five petals, five or ten stamens, and five pistils; but sometimes the prevailing number is four.

The **Monocotyledonous** type usually presents three sepals, three petals, three or six stamens, and three pistils.

A **Complete** flower is that in which all the whorls are complete.

A **Symmetrical** flower has the same or a multiple number of parts in each whorl.

A **Regular** flower is so called when every part of the same whorl is identical in colour, size, and shape.

A **Dichlamydeous** flower has both calyx and corolla; if one of these be absent, the other is termed the calyx; in such case, however, the term **Perianth** is often used.

A **Monochlamydeous** flower possesses only one (the outer) whorl.

An **Achlamydeous** or naked flower has no outer whorl at all.

Apetalous is the term given to the flower when the corolla is absent.

A Perfect or **Hermaphrodite** flower is that in which *[illegible]here are both* stamens and pistils.

An **Imperfect** or **Diclinous** flower is that in which only one set of these essential organs is present.

A **Staminate** or male flower is one containing only stamens (indicated by symbol ♂).

A **Pistillate** or female flower contains only pistils (indicated by symbol ♀).

Monœcious is the term which implies that there are male and female flowers respectively upon the same plant. Example, Oak.

Diœcious, when these different flowers are upon different plants. Example, Willow.

Polygamous, when one plant contains male, female, and hermaphrodite flowers.

Neuter flowers have no sexual organs at all.

Example, outer whorls of capitula of some compositæ.

A flower is said to be **Symmetrical** when all its whorls are of the same number, or some multiple of that number.

Asymmetrical, when the reverse obtains. The pistilline whorl is not concerned in this symmetry.

But if it contains the same number of whorls as the other parts of the flower, the name **Isomerous** is employed.

If not, **Anisomerous**.

Binary or **Dimerous** implies that there are only *two* organs in a whorl.

Ternary or **Trimerous**, that there are *three*.

Quaternary or **Tetramerous**, *four*.

Quinary or **Pentamerous**, *five*.

The last is common among Dicotyledons; the Ternary amongst Monocotyledons.

A calyx is said to be **Polysepalous** when its sepals are distinct; **Gamosepalous**, or **Monopetalous**, when they are united.

Similarly, a corolla is **Polypetalous** or **Monopetalous**.

Stamens are called **Monadelphous** when they are united together at their lower parts, forming only a single bundle; **Diadelphous**, when forming two bundles; and **Polyadelphous**, when forming more than two.

Syngenesious is the name used when the union of stamens takes place only at the upper part.

Hypogynous is the term applied to stamens which are inserted below the pistil.

Perigynous, when a calyx tube is formed by the union of sepals, petals, and stamens before they reach the receptacle, the stamens surrounding the pistil.

Epigynous, when the calyx tube closely adheres to and surrounds the pistil, so that only its top is visible, the stamens being above the pistil.

The flowers possessing hypogynous stamens with the sepals and petals distinct are classed under the name of **Thalamifloræ.**

Those having their stamens inserted into the calyx tube, either perigynous or epigynous, under **Calycifloræ.**

Those with a gamopetalous corolla, into which the stamens are inserted (perigynous), under **Corollifloræ.**

When the calyx is adherent to and completely covers the ovary it is said to be **Superior**, the ovary being then **Inferior.**

The calyx is inferior, the ovary superior, where the sepals are free and inserted below the ovary.

Gynandrous is the term used when the stamens are adherent to the pistil.

Æstivation or **Præfloration** implies the folding of the flower-bud. We have here the same forms as in Vernation, with the addition of a variety known as **Corrugate** or **Crumpled**, together with the Vexillary Æstivation, found in some plants of the order *Leguminosæ*, in which the flower is so arranged that there are a *vexillum* or *standard* and two lateral *alæ* or wings, *enclosing a carina* or *keel.*

The outermost leaf-whorl is termed the calyx, but this sometimes has an *epicalyx* composed of bracts. The sepals are said to be distinct in the typical flower, and are then called **Polysepalous**. When they cohere the name **Gamosepalous** is given to them.

These sepals are sometimes coloured or *petaloid*, but they are usually green* and sessile. They are generally entire, but admit of various modifications. For instance, in the Aconite they are coloured and form a hood (napellus, a monk's hood).

Sepals whose extremities turn inwards are called **Connivent**; those whose extremities turn outwards, **Divergent**, but they often stand erect.

In a **Gamosepalous calyx** the coherent part is called the **Tube**, its upper extremity the **Faux** or **Throat**, and the free portion the **Limb**, composed of lobes if the cohesion be incomplete. The lobes are separated by sinuses.

Caducous is the name given to sepals that fall off.

Deciduous, when they fall off contemporaneously with the corolla.

Persistent, when they remain attached to the ripening fruit.

Marcescent, when the calyx remains withered, but loosely attached to the fruit.

Accrescent, when continuing to grow, forming a bladder-like covering over the fruit.

Sepals are sometimes very small, shrivelled, or modified, so as to form, as in Compositæ, a so-called **Pappus**. Here the calyx is a typical one at its lower part, but as the fruit ripens it splits up into a mass of thin filamentary threads.

OFFICINAL FLOWERS.

Ammoniacum. Dorema Ammoniacum.
Anthemis. Anthemis Nobilis. Chamomile.

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* *Green is* not considered a colour in Botany.

Aurantii Floris Aqua. Citrus Aurantium and Citrus Bigaradia. Orange.
Cannabis Indica. Cannabis Sativa. Indian Hemp.
Caryophyllus. Caryophyllus Aromaticus. Clove.
Kousso. Brayera Anthelmintica. Cusso.
Lavandula. Lavandula Vera. Lavender.
Lupulus. Humulus Lupulus. Hop.
Sambucus. Sambucus Nigra. Elder.
Santonica. Artemisia Santonica.

VIII.—THE COROLLA.

The **Corolla** is composed of modified leaves called **Petals.** These usually possess a contracted part termed the **Unguis** (claw), and are then called **Unguiculate.** The spreading part of the petal is called the **Limb**; when the petals are cut into fringes they are called **Fimbriated.** Boat-shaped petals are termed **Navicular**; spoon-shaped, **Cochleariform.** When pouch-like processes proceed from them they receive the name of **Spurred, Saccate,** or **Gibbous.**

The term **Nectary** implies that when there is more than one whorl of petals, some may be so reduced in size that they become abortive.

When the petals are all distinct the corolla is termed **Polypetalous**; when they are united the corolla is said to be **Gamopetalous.**

There are four forms of **regular Polypetalous Corolla** :—

1. The **Cruciform** or **Cruciferous.** This has four petals, unguiculate, and in the form of a St. George's cross (*see* order Cruciferæ).
2. The **Caryophyllaceous.** In this there are five petals, enclosed by the calyx tube, the claw *long,* and the limbs diverging at about right

angles from the claw (order Caryophyllaceæ).

3. The **Rosaceous**, five petals, claws absent, or obsolete, and spreading irregularly (order Rosaceæ).
4. The **Liliaceous**. Petals forming a funnel before spreading (order Liliaceæ).

The only **Irregular Polypetalous Corolla** to which a distinct name is given is the **Papilionaceous** or **Butterfly-like** form. In this the five petals are arranged so that the **vexillum** or **standard** is very large, and situated posteriorly. Two **alæ** or **wings** are placed at its sides, and the **carina** or **keel** is composed of two small pieces uniting anteriorly.

The forms of the **Regular Gamopetalous Corolla** are the following :—

1. The **Tubular**; consisting of a nearly cylindrical tube throughout, as in the central flowers of some of the Compositæ.
2. The **Urceolate** (urn-shaped); a modification of the Tubular, with the tube expanded at centre; only slightly contracted at base and apex, as in the Heath, Erica.
3. The **Campanulate** (bell-shaped); the tube dilating from base to apex, gradually and continuously, as seen in the Hare-bell.
4. The **Infundibuliform** (funnel-shaped); like the Campanulate, but with a long tube contracted upwards from the base, the limb gradually dilating at the top, as in Nicotiana Tabacum (the Tobacco plant).
5. **Hypocrateriform** (salver-shaped); having a long narrow tube, from which the limb suddenly diverges at a right angle, as in the Primrose.

6. The **Rotate** (wheel-shaped); in this the tube is very short, but in other respects is exactly like the Hypocrateriform, as in the Potato.

Irregular Gamopetalous Corollas are the three following:—

1. The **Labiate, Bilabiate,** or **Lipped**; the limb is divided into two lips, an upper and lower, the former being generally composed of two united petals, the latter of three, and this may be entire or trifid (order Labiatæ).
2. The **Personate** or **Mask-shaped**; in this the throat is partially occluded by the lower lip or palate, which is bent back, as in the Snapdragon. A modification of this occurs in Calceolaria, where the lips are hollow, like a slipper, and called Calceolate.
3. The **Ligulate** or **Strap-shaped**; a tubular corolla, in part split up, so as to form a flattened band, as in the Dandelion. There are indentations at the end of the strap indicating the number of petals composing it.

A **Nectariferous** petal is seen in the Ranunculus, which possesses a scale-like organ at its base called a Nectary.

Like the calyx, a corolla may be deciduous, caducous, or persistent.

When the corolla is persistent and withers up it becomes marcescent.

OFFICINAL PETALS.

Rhœas. Papaver Rhœas. Red Poppy.
Rosa Centifolia. Cabbage Rose.
Rosa Gallica. Red Rose.

IX.—THE STAMENS.

A collection of stamens is called an **Andræcium.** The **Stamen** is a flower-leaf modified in order to produce the **pollen,** a powdery substance destined to fecundate the ovule. It is generally furnished with a thread-like organ called the **Filament,** upon the summit of which is placed the **Anther.**

This **Anther** is usually divided into two **Lobes,** in the interior of which are one or more **Loculi** or cells containing the pollen.

When the filament is absent the anther is termed **Sessile.** When the anther is absent the stamens are **Sterile.**

The **Filament,** when thread-like, is called **Filiform;** when hair-like, **Capillary.** It is termed **Subulate** or awl-shaped when it tapers from base to apex, and **Clavate** or club-shaped when from apex to base;

Moniliform or necklace-shaped, as in the nettle, when it appears like a row of beads.

The **Anther** is usually oblong, and in it are found two parts: the **Face** and **Dorsum** or back. Where the ripe anther opens is placed the **Suture.** If the face of the stamen turns towards the pistil, the anther is called **Introrse**; when the face looks towards the petals it is termed **Extrorse.** The filament is joined to the anther in one of three ways, as follows:—

1. **Innate**; the filaments passing without interruption into the connective.
2. **Adnate**; filaments not passing directly into base of connective, but running along its back near the base and continued along the connective.
3. **Versatile**; the filament joining the connective near its middle, the anther being balanced upon a fine point.

The **Connective** is generally a solid body, by which the two adjacent anther-lobes are united, and neither *falls short* nor extends beyond their extremities.

When young the anthers usually have four cavities (*quadrilocular*); but when ripe they have generally but two (*bilocular*); occasionally only one cavity is left (*unilocular*).

Dehiscence implies the bursting of the anther to allow the escape of the pollen.

It is of four kinds, viz.:—

1. **Longitudinal**, when the anther bursts in the line called the suture.
2. **Transverse**, when the anther-lobes are twisted on their axes, presenting their apices or bases towards the connective, the opening running across the anther.
3. **Porous**, when there are small openings at the apex of the anther, through which the anther bursts.
4. **Valvular**, when the wall of the anther gives way, but remains attached at one point so as to form a hinge, leaving a lateral opening.

If the stamens, petals, and sepals are equal in number, the flower is called **Isostemonous**; if this is not the case, then **Anistemonous**; if the sum of the sepals and petals equal the number of stamens, **Diplostemonous.**

Stamens are called **Epipetalous** when placed upon the inner faces of the petals.

Occasionally some stamens are longer than the others. If there are two long and two short, they are termed **Didynamous**; if there are four long and two short, they receive the name of **Tetradynamous.**

If the stamens cohere by their filaments into one bundle, they are **Monadelphous**; if into two bundles, **Diadelphous**; into three, **Triadelphous**; if into more than three, **Polyadelphous.** Should they be united by *their anthers,* they are termed **Syngenesious.** When *coherent to the* pistil, they are called **Gynandrous.**

X.—THE PISTIL.

The pistils occupy a position interior to the stamens, each individual constituent of their whorl being termed a **Carpel**, which may be regarded as "*a conduplicate leaf with the edges turned inwards.*" In the lower part of the carpel is a cavity containing the ovules, and to this the name of **Ovary** is given, and the inturned edges of this ovary form the **Placenta**. Upon the top of the ovary is usually found a slender body, the **Style**, at the termination of which is the **Stigma**. In the absence of the style the stigma is termed **Sessile**.

The carpel, and consequently the pistil, may be solitary; but there may be two or more carpels, and when they are very numerous they are said to be **Indefinite**. If there are a number of distinct carpels in a flower, they are said to be **Apocarpous**; if they cohere together, they are termed **Compound** or **Syncarpous**.

Between the cells of adjacent ovaries are partitions called **Dissepiments**. When there are many, and they project so as to unite in the centre of the ovary, this organ is called **Multilocular**, and the **Placentation** is said to be **Central**. If the partitions project only a short distance from the wall of the ovary, the fruit is then called **Unilocular**, and the placentation is termed **Parietal**.

Officinal Stigma and part of **Style**:—

Crocus Sativus. Saffron.

XI.—THE OVARY.

When this consists of one carpel it is called **Simple**; when of more than one, **Compound**. It is usually without a stalk, but when this is present it is termed a

Gynophore, and the ovary receives the name of **Stipitate**.

The **Placenta** is considered to be "*the inturned and conjoined edges of the carpellary leaf*," and, as has been noticed above, may be **Free**, **Central**, or **Parietal**.

The **Style** generally arises from the summit of the ovary, and is then called **Apical** or **Apicilar**; but when it arises from the side it is termed **Lateral**; when from the base, **Basilar**.

The **Stigma** may be **Simple** or **Compound**, and when the carpels are not united it is **Distinct**.

Terminal is the appellation when the stigma is at the extremity of the style; **Lateral** when the components of the style are not united at their upper parts.

A **Stigma** is termed **Capitate** when it forms a distinct swelling at the top of the style. The stigmas are **Penicillate** or **Feathery** in Grasses; **Lobed** in Compositæ; **Radiate** in Papaveraceæ; **Lateral** in Leguminosæ; and **Petaloid** in Iridaceæ.

XII.—THE FRUIT.

By fecundation by the pollen the ovule is finally converted into a seed, and this, together with its covering, forms the fruit.

The case or covering of the fruit is termed the **Pericarp**. It may be either dry or succulent.

When dry *no distinct* layers are perceptible, but when succulent *three parts* may be distinguished, viz. :—

1. The **Epicarp**, corresponding to the epidermis of the lower surface of the leaf.
2. The **Mesocarp**, corresponding to the parenchyma of the lower surface of the leaf.
3. The **Endocarp** or **Putamen**, corresponding to the epidermis of the upper surface of the leaf, *enclosing* the seed.

XIII.—DEHISCENCE.

Fruits are called **Indehiscent** in which there is a hard pericarp, and which fall from the plant without allowing the escape of the seed.

If the fruit breaks up and allows the ripe seed to escape, it is called **Dehiscent.**

There are three modes of **Dehiscence**, viz. :—

1. **Valvular**; the fruit opening longitudinally along the lines of their natural sutures, the parts falling in the form of valves.
   - (*a*) **Septicidal**; the carpels of a syncarpous pistil separating, and dividing the septa into component parts.
   - (*b*) **Loculicidal**; the septa entire, each carpel opening at its dorsal suture.
   - (*c*) **Septifragal**; each dissepiment broken transversely, the placenta standing in the centre of the ovary and entirely separate from the walls.
2. **Transverse** or **Circumscissile**; the upper and lower part of the fruit separated by a transverse rent, the latter being left uncovered by the former falling off like a lid.
3. **Porous**; the fruit opening only by small pores.

Fruits may be divided into **Simple** (produced by a single flower) and **Multiple** (by more than one flower). Of the former there are two subdivisions : **Apocarpous** and **Syncarpous.**

The Apocarpous may be **Simple** or **Compound**; the Syncarpous **Inferior** or **Superior.**

The **Simple Apocarpous Fruits** are two in number, viz. :—

1. The **Legume**; dehiscing by dorsal and ventral sutures.

2 The **Lomentum**; differing from the foregoing by its moniliform constrictions at intervals.

(*a*) The **Utricle** is a simple apocarpous fruit sometimes dehiscing, and is one-celled or many-seeded, with a loose membranous pericarp.

(*b*) The **Drupe** is a simple apocarpous fruit never dehiscing, and is one-celled and one-seeded; made up of a fleshy sarcocarp and a bony endocarp.

Compound Apocarpous Fruits are the following :—

1. The **Follicle**; dehiscing only by a single suture.
2. The **Achene**; an indehiscent fruit with only one cell and one seed. It is tipped by the remnant of the style.
3. The **Hetærio**; examples of which are:
   (*a*) The **Strawberry**; an enlarged and succulent receptacle, upon which are numerous achenes.
   (*b*) The **Raspberry**; in which the receptacle is fleshy, *not succulent,* and supports a number of drupes.
4. The **Cynarrhodum** or **Rose-hip**; an inverted hetærio, consisting of achenes received into a hollowed succulent receptacle.

Superior Syncarpous Fruits are these :—

1. **Indehiscent.**
   (*a*) The **Caryopsis**, composed of two carpels usually, and having a *dry closely attached* pericarp (as in Grasses, Oats, etc.).
   (*b*) The **Samara**, having two or more coherent achenes, the margins being winged (Ash and Elm).

(*c*) The **Carcerulus**, a collection of **cocci** or carpels, separated from the base of the carpophore, but connected at the upper part.

(*d*) The **Tryma**, a compound drupe (Walnut), sometimes having a fibrous outer coat (Cocoa-nut).

In the above ((*a*), (*b*), (*c*), (*d*)) the pericarp is **Dry.** In the following the pericarp is **Succulent**:—

(*a*) The **Nuculanium** or **Uva**, a fruit with a pericarp, enclosing numerous seeds enveloped in pulp (the Grape).

(*b*) The **Hesperidium** or **Orange**; like the grape, but the septa are permanent, within which is the pulp, and surrounding which is the rind.

2. **Dehiscent.**

(*a*) The **Capsule**, a fruit one or more celled, many-seeded, with Valvular dehiscence in Colchicum; Porous dehiscence in Poppy; and Transverse dehiscence in Hyoscyamus, in which case it is called a *Pyxidium.*

(*b*) The **Siliqua** consists of two carpels only, with parietal placentation. It contains a *replum* or false septum, and the dehiscence is valvular. A silicula is a short and broad siliqua (order Cruciferæ).

Inferior Syncarpous Fruits:—

1. **Indehiscent,** *dry* and *succulent.*

The **Dry** are :—

(*a*) The **Glans** or **Nut**, a one-celled, single-seeded fruit, and generally seated in a whorl of bracts or cupule (the Acorn).

(*b*) The **Cypsela**, an inferior achene, with a calyx in form of a pappus (in Compositæ).

(*c*) The **Cremocarp**, an inferior carcerulus, composed of two carpels called *Mericarps* (in order Umbelliferæ).

The **Succulent** are :—

(*a*) The **Bacca** or **Berry**, an inferior nuculanium (the Gooseberry).

(*b*) The **Pomum** or **Apple**, like the bacca, but possessed of an endocarp forming a more or less bony core (Apple, Hawthorn).

(*c*) The **Pepo** is three-celled and pulpy, with a thickened rind.

(*d*) The **Balausta** or **Pomegranate** is remarkable for having its carpels in two stories placed side by side.

2. **Dehiscent.** This fruit is seen only in the Campanula, and is called **Diplotegia**; it is exactly like the capsule, except that it is inferior.

Multiple or Anthocarpous Fruits :—

1. The **Cone**, an elongated fruit composed of hardened scales, each bearing in its axil one or more seeds, which are naked and called Gymnosperms (the Pines and Cycads).
2. The **Galbulus** is more rounded than the Cone, and the extremities of its scales are flattened like a nail-head (in the Cypress).
3. The **Strobilus**; in this the scales are membranous, and the seeds enclosed in carpels, but otherwise it is like the Cone (the Hop).
4. The **Sorosis**, the ripe product of numerous flowers, appearing single on account of their close coherence (Mulberry and Pine-apple).
5. *The* **Syconus**, a ripe Cœnanthium (the Fig).

OFFICINAL FRUITS.

Anethum. Anethum Graveolens. Dill.
Anisum. Pimpinella Anisum. Anise.
Aurantium. Citrus Bigaradia and Citrus Aurantium. Orange.
Bela. Ægle Marmelos. Bael.
Capsicum. Capsicum Fastigiatum.
Carum Carui. Caraway.
Cassia. Cassia Fistula.
Colocynthis. Citrullus Colocynthis.
Coriandrum Sativum. Coriander.
Conium Maculatum. Hemlock.
Cubeba Officinalis. Cubebs.
Elaterium. Ecbalium Officinarum. Squirting Cucumber.
Ficus Carica. Fig.
Fœniculum Dulce. Fennel.
Juniperus Communis. Juniper.
Limon. Citrus Limonum. Lemon.
Lupulus. Humulus Lupulus. Hop.
Morus Nigra. Mulberry.
Olea Europæa, yielding { Glycerinum. Olivæ Oleum. Sapo Durus. Sapo Mollis.
Papaver Somniferum. White Poppy.
Pimenta. Eugenia Pimenta. Pimento.
Piper Nigrum. Pepper.
Prunum. Prunus Domestica. Plum.
Rhamnus Catharticus. Buckthorn.
Rosa Canina. Dog Rose.
Ruta Graveolens. Rue.
Sabadilla. Asagræa Officinalis.
Tamarindus Indica. Tamarind.
Vitis Vinifera. Grape.

XIV.--THE OVULE.

The **Ovule**, in its earliest condition, takes origin from the "*inturned edge of a carpellary leaf*," and when it has been fecundated, and contains an embryo, is termed a *Seed.*

An ovule is termed **Solitary** when there is only one in an ovary.

When the number can be counted with ease the ovules are called **Definite**;

When the ovules are very numerous, they are said to be **Indefinite.**

An **Erect Ovule** is that which appears to rise from the base of the ovary and to stand upright.

A **Pendulous Ovule** is that which hangs from the summit of the ovary.

It is called **Ascending** when it apparently rises from the side near the bottom, and is directed upwards.

It is **Suspended** if near the top, and hangs downwards. Should it grow straight outward, it is called **Peltate** or **Horizontal.**

At first the ovule presents a small projection from the placenta, termed the **Nucleus**; this increases until it is separated by a slender cord termed the **Funiculus** or **Podosperm.** Two coverings for the ovule are by degrees developed from its base, where it is joined by the funiculus, and this point is called the **Hilum.** The inner covering is called the *Integumentum Internum;* the outer the *Integumentum Externum.*

The ovule is not completely covered by either of these coats, but a small space is left called the **Micropyle** or **Foramen**, the opening in the internal coat being called the **Endostome**, that in the outer the **Exostome.**

Contemporaneously with these formations is formed a cavity called the **Embryo Sac.** The spot where the *funiculus actually* joins the nucleus is termed the [illegible]*alaza.*

When the base of the ovule turns towards the placenta, and its apex away from it, the ovule is termed **Orthotropous.**

If the chalaza turns away from, and the micropyle towards the placenta, the ovule is called **Anatropous.**

In the latter case the micropyle and hilum are close together, and the funiculus forms a cord-like projection on the surface of the ovule termed the **Raphe.**

If the ovule becomes bent upon itself like a U, and brings the hilum and chalaza in contact with the micropyle, it is termed **Campylotropous.**

When the funiculus is elongated so as to push the chalaza up and the micropyle down, thus causing the long axis of the ovule to be horizontal, it is called **Amphitropous.**

XV.—THE SEED.

The **Seed** consists of an outer covering called the **Testa** or **Episperm,** and an inner the **Tegmen.** The former is either woody, membranous, soft, or pulpy. Occasionally a third covering is present; this is called an **Arillus,** when growing upwards and originating from the funiculus; and an **Arillode** when growing downwards and originating from the micropyle. By the side of the embryo, or enveloping it, is placed the albumen (when present), called **Peri-** or **Endo-sperm.**

Albuminous Seeds are those possessing this endosperm; **Exalbuminous** when it is absent. The albumen may be *starchy* or *mealy* (in the Wheat), *fleshy* (in the Barberry), *mucilaginous* (in the Mallow), *hard* and *bony* (in the Ivory-nut). It is termed *Ruminated* in the Nutmeg, where it presents a mottled appearance.

The Embryo itself consists of a **Plumule** or **Radicle** and one or more cotyledons.

The **Plumule** always turns away from the micropyle, *the radicle* towards it.

Plants containing two seed-lobes receive the name of Dicotyledons; plants containing only one seed-lobe are called **Monocotyledons.**

Plants with many seed-lobes (a rare circumstance) are termed **Polycotyledons.**

Those with no seed-lobes, as in all **Cryptogamic Plants**, receive the name of **Acotyledons.**

If the **Embryo** occupies the centre of the kernel, it is termed **Axial**; if without its centre, **Eccentric** or **Abaxial.** It may be straight, curved, spiral, hooked, or folded. When it is folded it is **Incumbent** (the radicle folded over the back of the cotyledons), or **Accumbent** (the radicle lying along the edges of the cotyledons).

XVI.—GERMINATION.

The embryo of a ripe seed, when placed under the proper conditions, enlarges, becomes active, and, rupturing its surrounding coats, produces a new plant.

This process is termed germination.

The chief necessary conditions for its production are **Moisture, Heat, Air,** or **Oxygen.**

It is favoured by the absence of light.

The heat most favourable to germinating plants is a temperature of 60° to 80° Fahr. Much greater heat is required by some tropical plants; and germination takes place in some of the Cryptogamæ a very little above the freezing point.

So long as a seed is dry, it will not sprout, but directly moisture reaches it the embryo commences its development. Water being absorbed, the cells become dilated, and the integument broken, thus admitting the exit of the embryo; by the action of heat, a sort of ferment (diastase) is formed, by which the starch of the embryo is converted into dextrine and grape sugar *(glucose).* These substances nourish the plant.

That these changes may take place, air or oxygen is requisite; carbonic anhydride is given off, and heat is evolved.

If buried deep in the soil, a seed will not germinate. A seed will sprout more readily in the dark than in the light, and more in diffused daylight than in direct sunlight.

Chemical rays of the solar spectrum are more favourable to germination than light-yielding rays.

The most favourable conditions for germination are that the seed be placed at a moderate depth in the soil, which is well powdered to permit the entrance of air, and prevent moisture and heat escaping. Larger seed should be planted at a greater depth than smaller ones.

The time requisite for the germination of a seed greatly varies, being longest in those which have been dried and have a dense coat, and shortest in those which readily take up water.

The appearance of the embryo is hastened by soaking the seed in water.

Germination of Dicotyledons.

In **Dicotyledons** the nutrient supply of the seeds is either in the embryo itself, and in the cotyledons especially, or in the form of perisperm surrounding it.

When these seeds commence to sprout, the radicle first appears at the micropyle or foramen, and then the protrusion of the cotyledons follows.

In some cases the cotyledons remain below the ground, and are called **Hypogeal**; in others they rise above the ground in the form of leaves, and are termed **Epigeal.**

The plumule appears between the two cotyledons, which are at times so cut up that the embryo seems **Polycotyledonous,** as is observed in the Pinaceæ or *Coniferæ.*

No necessary relation is borne by the cotyledonary leaves to the vegetative or true leaves.

Germination of the Monocotyledons.

The embryo in many **Monocotyledons** presents no distinct parts, and merely resembles a conical mass, tapering at one end, nearly truncated at the other, and having a slit towards its base.

Through the slit appears the plumule, and from the truncated end are developed adventitious roots; the tapering part is the solitary cotyledon.

The radicle is never greatly developed, and from it adventitious roots are developed, by which the external covering of the radicle is pierced.

The majority of monocotyledonous seeds possess albumen, which is usually absorbed entirely.

In these seeds the solitary cotyledon is wholly or partially retained in the seed-coat during germination.

XVII.—FECUNDATION.

The existence of male and female flowers has been recognised from a very early period.

It is supposed that in fecundation or propagation of the individual the pollen of the stamens is thrown upon the stigma of the pistil, and so conveyed to the ovary.

Some female flowers, however, appear occasionally to produce fruit independently of any pollen agency; but, in general, the pollen has been conveyed from a distance, or, it may be, produced by flowers (in which only pistils are as a rule produced), giving rise to stamens.

To ensure the pollen grains being applied to the stigma, the relative lengths of the style and the stamens vary according to the nature of the flower, whether pendulous or erect, the stamens being shorter than the rmer and larger in the latter. In some ttle) the anthers burst forcibly, and the red in all directions.

very important agents in the fecundation ey are attracted by the presence of sugar ts, by the peculiar shape of others; and h they rub off the pollen, which they ext flower they alight upon.

th water must be avoided by pollen-hey may be ruptured by this fluid.

h, therefore, the flower is inverted or n most aquatic plants, the blossom is he water.

keeping the pollen becomes incapable of e ovule. In some cases (the Date Palm), s been kept for nearly twenty years, and fruit, whereas in some, as in the Tobacco less after forty-eight hours.

inaceæ there are produced very large ellow pollen; hence the so-called sulphur e large amount of pollen in these plants ifficulty of carrying pollen sufficient for n consequence of the diœcious or mo-cter of their organs of reproduction.

e pollen of a single anther suffices to e ovules contained in an ovary, and the ore than one stamen is merely to render enough pollen shall be conveyed to the

t of pollen necessary for the fertilisation ntirely varies with the number of the ned by the ovary; and even when the ed to the stigma, some allowance must be e of the grains not coming into contact a,

XVIII.—MORPHOLOGY.

With regard to their outward form, Plants are divided into :—

1. **Phanerogamic** or Flowering Plants (sexuality apparent) ; and
2. **Cryptogamic** or Flowerless Plants (sexuality concealed).

The **Phanerogamic** produce *flowers,* and seeds *containing an embryo.* They are divided into

1. **Exogenæ** and 2. **Endogenæ.**

THE EXOGENÆ OR DICOTYLEDONS.

At an early period of their history, the **Exogenæ** consist of an **Internal Parenchyma,** which is regular or irregular. External to this is a circle of **Indefinite Fibro-vascular Bundles** which anastomose with each other, forming a kind of network, the meshes of which are filled with bands of cellular tissue. These bands connect the central parenchyma or pith with the outer layer of flattened cells, by which eventually the bark is formed.

Between the bark and the fibro-vascular bundles is found the **Cambium** layer. The whole is enveloped by the **Epidermis.**

Thus, at this epoch, the composition of the Exogenous stem is the following :—

1. **Parenchyma of the Pith**
2. **Fibro-vascular Bundles**
3. **Cambium Layer**
4. **Parenchyma of the Bark**
5. **Epidermis**

} **Medullary Rays.**

This is the permanent condition of an herbaceous Dicotyledon.

The structure of one which is intended for a longer existence than two years is more complex.

In the latter is found a central pith, composed of cells. In plants of one or two years of age the pith relatively is not so large, to the rest of the stem, as in herbaceous or very young plants.

In rapidly growing plants, as in the Umbelliferæ, sufficiently numerous cells cannot be produced to fill the space intended for the pith, so that the stem is hollow, except at the root.

In the endogenous stems of grasses the same condition is present.

In the walnut tree a regular alternation of septa and cavities is observed; this arrangement constitutes the so-called *chambered* pith.

The internal portion of the fibro-vascular bundles, by which the pith is immediately surrounded, is composed of a ring of spiral vessels which are rarely seen in any other part of the stem.

This ring is termed the **Medullary Sheath**, and from it vessels are sent off to the leaves. The greater portion of the stem is, however, found to consist of bundles of woody fibres, usually combined with pitted or dotted ducts, and the whole is arranged in concentric circles, each circle constituting a year's growth. The medullary rays running from the pith to the bark break up these circles into wedge-shaped masses.

In the transverse section circular marks appear, which arise from the ducts being more internal than the woody fibres, and from smaller compact cells being produced at the end of the season, and the arrest of growth by cold during winter.

In tropical countries the stoppage of growth is usually due to drought. In these regions more than one ring may be produced in the plant of one year, and again, in some tribes, as the Cycas, a single circle requires several years for its completion.

Generally speaking, however, by counting the concentric rings, and accrediting one to each year, the age of an Exogenous tree can be ascertained with accuracy.

The ducts usually are surrounded by woody fibres, but there are many variations.

The wood of the Coniferæ is almost exclusively composed of punctated or glandular tissue. With increase of size of the trees the older parts of the wood increase in density, since secondary deposits are formed within their cells, and at length these become impervious.

This central portion is termed the **Heartwood** or **Duramen**, which is frequently of a different colour from the rest of the stem, in consequence of the deposition in it of peculiar secretions, as observed in the mahogany and ebony tree.

The external part, in which the cells are not so thickened, is termed the **Alburnum** or **Sapwood**, since through it ascend the fluids destined for the nourishment of the plant.

It has been stated that the wood is arranged in wedges, bounded laterally by the medullary rays. These rays are composed of brick-shaped cells placed one over the other (muriform parenchyma), and belong to the horizontal system of the plant. They connect the cellular system of the pith with that of the bark.

The rays which extend the whole distance from the bark to the pith are termed **Primary**. As the original wedge of wood, however, increases in breadth year by year, it is simultaneously cut up by a new set of rays, and these only stretch to the bark from the ring of the year in which they took origin, and are thus termed **Secondary**.

In all growing plants, and immediately external to the sap-wood and separating it from the bark, is found a layer of cells retaining their primordial utricles. To this layer the term **Cambium** is given. It is of a green colour. From the cambium layer the wood internally and the bark externally are developed.

To the presence of the cambium is due the peculiar quality of unlimited growth in the Exogenæ.

The collective name of bark is applied to the structures outside the cambium, and four sets of these may be recognised :

1. **Liber or Endophlœum.**
2. **Green Cellular Layer or Mesophlœum.**
3. **Suberous, Corky Layer or Epiphlœum.**
4. **Epidermis.**

The parenchymatous structures are here internal, the cellular being external, whereas in the wood the reverse is the case. The bark, moreover, grows from the inside, and not from the outside.

Upon section, then, an **Exogenous Tree** presents the following parts :—

1. **The Epiphlœum or Cuticle**	The **Bark**.
2. **The Mesophlœum or Cortex**	
3. **The Endophlœum or Liber**	
The Cambium Layer (in growing plants).	
4. **The Soft Wood or Alburnum**	The **Wood Proper.**
5. **The True Wood or Lignum**	
6. **The Medullary Sheath**	
7. **The Pith or Medulla**	

The **Leaves** of these plants are **net-veined** and articulated to the stem. The embryo consists of never less than **two Cotyledons** and occasionally of more. The sepals and petals, when they exist, are in fours or fives, seldom in threes. The embryo has rarely more than two seed-lobes.

The roots are **Exorrhizal,** *i.e.*, taking origin by development of the radicle outside the root.

The **Exogenæ** are divided into :—

1. **Angiospermia,** or those with **covered** seeds; and
2. **Gymnospermia,** or those with the seeds **naked.**

The **Angiospermia,** again, include the five following varieties :—

- (*a*) **Thalamifloræ,** in which the corolla is polypetalous, and stamens are hypogynous.
- (*b*) **Calycifloræ;** corolla polypetalous; stamens either epigynous or perigynous.
- (*c*) **Corollifloræ;** corolla monopetalous; stamens inserted into the petals (epipetalous).
- (*d*) **Monochlamydeæ;** with calyx only.
- (*e*) **Achlamydeæ;** wanting both calyx and corolla.

THE ENDOGENÆ OR MONOCOTYLEDONS.

In these the stems are composed of parenchyma not separable into pith and bark, called endogenous in consequence of the peculiarity of the development of the fibro-vascular bundles.

There is a general pith in which curved fibro-vascular bundles are arranged peculiarly. The bundles pass bodily into the leaves with which they are connected at their upper extremities, and at their lower extremities they bend outwards, and, by interlacing, compose a network which separates the central from the cortical parenchyma.

Occasionally the cells of the cortical part retain for *a time the* primordial utricles, and form a kind of cam[illegible]*ium layer, differing* from that of the Dicotyledons in enlarging the bundles, not at the side, but at their extremities only.

In the herbaceous Monocotyledons the stem is composed of a succulent parenchyma having fibrous, stringy bundles diffused through it, and even where woody stems are present, their hardness depends rather upon the hardening of the parenchyma by secondary deposits than upon the fibro-vascular bundles.

The exterior of the endogenous stem is bounded by a rind, which consists of spongiform parenchyma, upon which are a few layers of tubular cells, in some cases made up only of simple epidermis, but of corky texture when most developed.

The fibro-vascular bundles take origin at the organic apex of the plant or punctum vegetationis, and from this they bend outwardly, downwards towards the root, and upwards towards the leaves; and, if the stem is of great length, they arrive at the rind before getting to the root; of the two curves, the upper is the more abrupt.

The lower part of the bundles is connected intimately with the rind, which is inseparable from them.

The most fibro-vascular bundles being contained in the outer part of endogenous stem, this part is harder than the internal.

Endogenous stems are usually **cylindrical**, since the cortical part soon hardens, and thus the stems are not capable at an early period of increasing their diameter. An exception is observed in the case of the Dracæna or Dragon Tree, in which the hardening does not take place, and which may attain a great size.

The **leaves** are marked by **parallel straight veins**, often sheathing the stem at their bases. The embryo contains only **one cotyledon**, and the parts of the flowers are in threes.

The *roots* are **Endorrhizal**, *i.e.*, the radicle never developed; but below the rind of the stem in the lower part conical projections of cellular tissue arise, which pass through the rind, and carry before them a portion formed like a conical cap (the *Pileorhiza*), part remaining as a collar and clasping the rootlet.

The trunk is of a uniform structure, in which no concentric rings can be made out; and the wood increases internally. There is no true bark, and the age approximately is obtained by finding the annual growth, and dividing the height of the tree by that amount.

The **Endogenæ** are subdivided into :—

(*a*) **Spadicifloræ**; flowers upon a spadix; either naked or enclosed in a sheath or spatha.

(*b*) **Petaloideæ**; flowers mostly with corolla and calyx, both green or both coloured, or the inner coloured and outer green.

(*c*) **Glumiferæ**; flowers in spikelets with scaly or bristly perianth; leaves with sheaths, either slit or tubular, and generally linear; seeds albuminous.

THE CRYPTOGAMÆ

Differ from the Phanerogamæ,

1. In the structure of their sexual organs, and their absence of flowers.
2. Their reproductive bodies (spores) are deficient of an embryo, and generally consist of simple cells.

They are divided into **Acrogenæ** and **Thallogenæ**.

THE ACROGENÆ.

Have a distinct stem and leaves, and possess stomata (breathing mouths). Parenchymatous cells compose the stems, and in their centre are sometimes found wood-cells and fibro-vascular bundles.

These are divided into :—

1. **Filices** or **Ferns.**
2. **Equisetaceæ** or **Horsetails.**
3. **Musci** or **Mosses.**
4. **Hepaticaceæ** or **Liverworts.**
5. **Marsileaceæ** or **Pepperworts.**
6. **Lycopodiaceæ.**
7. **Characeæ.**

FILICES OR FERNS.

In these the **Fronds** or **Leaves** are greatly developed, the stems only slightly so, usually remaining underground as rhizomes, which develop in a vertical or horizontal direction, the latter giving off their leaves singly, the former in tufts. The tufted condition is due to the non-development of internodes, and may be observed in the Tree Ferns and in the Lady Fern.

In the case of the arborescent ferns, however, the stem often attains a great height.

The **Fronds** or leaves present nearly the same structure as in the Phanerogamæ, but they are frequently much cut up, and their vernation is usually circinate, except in the Ophioglossaceæ.

The **Venation** is **forked**, and the fruit is generally seen in the forks of the veins.

The **Spores** are collected into **conceptacles** or **sporangia**; these are little membranous sacs, found as a rule on the lower surface of the leaf.

In the majority of the Polypodiaceæ the sporangium is partly surrounded by a ring of cells termed an **Annulus,** which assists in the rupture of the sac when ripe.

The sporangia are collected below the leaf into groups called **Sori**; these are either **Naked**, or covered by a membrane, the **Indusium.**

The chief varieties of ferns are the following, viz.: **Polypodiaceæ, Hymenophyllaceæ, Gleicheniaceæ, Schizæaceæ, Osmundaceæ, Marattiaceæ,** and **Ophioglossaceæ.**

The annulus in the Polypodiaceæ is vertical. It is oblique in Hymenophyllaceæ; horizontal in Gleicheniaceæ; cup-shaped in Schizæaceæ; broad and imperfect in Osmundaceæ; and wanting in Marattiaceæ and Ophioglossaceæ.

The sporangia in Marattiaceæ are collected into a kind of multilocular cyst; they are concealed in cups at the edge of the leaf in Hymenophyllaceæ, and are elevated on spike-like processes in Ophioglossaceæ.

The spores resemble pollen grains, and possess two coats, of which the outer coat is frequently marked by papillæ.

EQUISETACEÆ OR HORSETAILS.

These are herbaceous plants, found generally in marshy localities. A solid jointed, subterranean rhizome represents the stem, from the surface of which arise other peculiar jointed, greyish-green striated stems. Whorls of small scales at each joint represent the leaves. The stems are either simple or compound. In some the compound stems are barren, and the simple ones fertile; in the latter case the stem ends in a club-shaped mass, which is composed of a short axis having a multitude of sporangia.

The **sporangia** are of a mushroom shape, and have minute pouches under their edges; these, when mature, burst and liberate the spores. Four short filaments called **Elaters** are attached to the spores.

The Ferns and Horsetails are characterised by having *only one* kind of spore, and by the formation of a *prothallium.*

MUSCI OR MOSSES.

The Musci have branched or filiform stems, the latter creeping, the former erect. The leaves are green, small, cellular organs, sometimes arranged in two rows, but generally imbricated. The fruit is produced either on lateral shoots, as in the creeping forms, or at the extremity of the stem, as in those that are erect.

The leaves subtending the fruit are called **Perichætial.**

The **Theca** or **Sporangium** springs from a portion called the **Archegonium**, and, during growth, carries before it a part of that organ which remains covering the theca, and is termed **Calyptra.** The remaining part closely surrounds the **Seta** or stalk of the sporangium (when existing), and is called the **Vaginula.**

In addition to the external envelope or **Calyptra,** the sporangium generally possesses a special lid or **Operculum,** which drops off and brings to view the mouth of the theca, around which is often a **Peristome** or fringe of teeth.

In the centre of the thecal cavity there is generally a **Columella** or cellular body, the rest being filled up with spores. The female organ is termed the **Pistillidium.** The male organ, the **Antheridium,** is a somewhat elongated, rounded body, internally hollow, and holding numerous cells or **Zoothecæ,** in each of which is contained a **Spermatozoid.** It is ruptured by an opening in the apex.

Numerous slender filiform bodies or **Paraphyses** surround the antheridia; these are in all probability abortive antheridia.

The antheridia and pistillidia may be on the same or on different plants.

The spores of musci possess two coats, and are similar to pollen grains.

HEPATICACEÆ OR LIVERWORTS.

There are two varieties of these, the forms of which are widely different. One, the Hepaticaceæ proper, possesses leaves and thalloid stems; the other, the **Jungermanniaceæ**, bears a close resemblance to the musci, and has creeping slender stems, similar to branching mosses; but, since the leaves are in two rows, the stem appears flattened.

The Hepaticaceæ proper, in the place of leaves and stems, present a kind of **Thallus**, which is analogous to the foliaceous stem of the Duckweed.

The sexual organs are represented by **Antheridia** and **Pistillidia** or **Archegonia.**

The antheridia are seated in the axils of the leaves in the Jungermanniaceæ, in the stalked receptacles in **Marchantia,** and in the frond in **Riccia.**

In structure they are analogous to that of mosses.

In the Marchantiaceæ and Jungermanniaceæ the archegonia reside in stalked receptacula.

In the Riccieæ they are imbedded in the frond.

The Pistillidia are flask-shaped and cellular, with an external case or **Epigone,** and contain a germ which after fecundation becomes enlarged, and breaks through its epigone, leaving this latter enveloping its base in the form of a sheath or **Vaginula.**

A so-called perigone frequently surrounds the vaginula, and the perigone is itself enveloped by perichætial leaves.

With the exception of Anthoceroteæ, the sporangia contain no **columellæ,** and **elaters** are mixed with the spores.

In the **Riccieæ** the sporangia are imbedded in the expansion of the thallus. In the Marchantia the *archegonia, from* which spring the sporangia, are situated *on the under surface* of peculiar peltate receptacula.

MARSILEACEÆ OR PEPPERWORTS

These consist of small herbaceous plants which grow in marshy situations or float on water.

The stem in the former kind consists of a slender, creeping rhizome; in the latter it merely serves as a basis for the leaves, which are filiform and small, ovate or quaternate.

The fruit consists of globular, stalked capsules called **Sporocarps,** which spring from the bases of the leaves.

In the sporocarps are contained **Thecæ** or **Sporangia,** and in the latter one or two kinds of spores.

The thecæ are contained in receptacula produced in the same (Pilularia), or in different (Salvinia) sporocarps.

LYCOPODIACEÆ.

In these the fruit is sessile, and not stalked, as in the preceding order. Their stems are creeping and slender, branching in a bifurcating manner, rooting at their bifurcations.

The leaves are imbricated and small, arranged in two vertical rows in Selaginella, and spirally in Lycopodium.

The fruit is in the shape of a cone, the spores being contained in cases, situated in the axils of the leaves.

In Selaginella the lowest sporangium in the cone gives origin to four large spores, which subsequently germinate; but in Lycopodium apparently there is only one kind of spore.

The Isoeteæ are aquatic plants. Their stems resemble a corm, and produce cylindrical, slender leaves (which contain air) from a solitary bud on the superior surface, and adventitious roots from the inferior surface. The sporangia reside at the sheathing bases of the leaves, and consist of numerous sacs. Some sporangia *yield spores* resembling pollen, whilst others produce spores similar to the large spores of Selaginella, which alone are capable of germinating.

The Lycopodiaceæ and Marsileaceæ are associated, in consequence of producing two sorts of spores.

CHARACEÆ.

The exact position of this order is somewhat doubtful, but they are usually placed under Acrogens.

In these the reproductive organs are of two kinds, and are seated at the base of their slender branches, either upon different plants or upon the same plant.

The sexual organs are called **Globules** and **Nucules.**

The **Antheridium** or **Globule** is globular and red in colour. It is placed close to the nucule, and is composed of eight valves made up of cells, and which radiate from a centre; each valve fits by teeth into its neighbour, and sends off from its centre an oblong-shaped cell, this latter uniting with those given off by the others at the centre of the globule. At this point they are met by the stalk of the globule, piercing its wall in order to unite with them. From the central points a large number of confervoid filaments arise, in each of which is contained a biciliated spermatozoid. The last-named body eventually escapes by suddenly rupturing the cell-walls.

The **Spore** or **Nucule** is of an oval shape, sessile in a branch-axil; five cells compose its wall, and are arranged in a spiral, being terminated by a crown of five or ten small cells. Protoplasm fills its interior. Between the crowning cells a channel is formed to afford access for the spermatozoids. When fertilised, the nucule falls off and germinates, somewhat similarly to the seed of a monocotyledon.

THE THALLOGENÆ

Have no distinct stem, stomata, leaves, or true buds. Their forms are only fairly regular, and they are purely cellular in structure.

They comprise :—

1. **Lichenes** or **Lichens.**
2. **Fungi** or **Mushrooms.**
3. **Algæ** or **Sea-weeds.**

LICHENES OR LICHENS.

In lichens the thallus is foliaceous or in the form of a crust. When foliaceous, it is more or less spreading; when crustaceous, it closely adheres to its support. Lichens are never aquatic, and generally grow in exposed localities.

In the thallus are usually observed two distinct layers, one firm, dry, and cortical, of a greyish colour, and a central part which is looser, of which the cells are colourless, and which contains some green cells termed **Gonidia.**

From the Gonidia plant-like buds or layers may be reproduced.

The organs of reproduction in lichens are of two kinds. One variety consists of hollows in the frond called **Perithecia,** which open on the surface by pores, and contain **Paraphyses,** having elongated cells called **Asci** or **Thecæ,** each of these containing four to eight spores.

The spores, when mature, make their escape by the perithecial openings.

To lichens possessing the above organs the name of **Angiocarpous** or **Angiosporous** is given.

The other variety of fruit is called an **Apothecium.** In this the same thecæ, with their spores, and paraphyses are present; but these are placed upon the superior surface of a kind of cup, either stalked or sessile. The stalk, when present, is termed a Podetium.

Lichens are termed **Gymnocarpous** when they have this kind of fruit.

The male principle appears to originate in chambers resembling perithecia; but these are smaller, and are called **Spermogonia.**

In the last are contained bodies called **Spermatia,** club-shaped bodies which are thought to be the agents in fertilisation.

FUNGI OR MUSHROOMS.

In these the vegetative and sexual organs are mixed up.

The **Myellium** or **Thallus** is alike in all, consisting of branched, tubular filaments, containing no colouring material. Its size varies very considerably.

Fungi occur most abundantly as parasites on living objects or in decaying organic matters. They are highly nitrogenised, and contain no starch or chlorophyll.

The spores in mushrooms are either naked or enclosed in cases. One kind of the former is called **Conidia**, and is capable of vegetative production.

In mildews and moulds a branching mycelium is found, and from this arise slender filaments, which are terminated by tufts of divers-coloured spores, either free or contained in sacs. To these is given the name of **Hyphomycetous** fungi.

From their mycelium or spawn some mushrooms produce a kind of fleshy mass, called **Stroma** or **Receptaculum**, in which are produced chambers resembling those of the angiosporous lichens, and also called **Perithecia.**

In these chambers are contained spores which are *supported upon* filaments called **Stylo-spores**, or upon tubular sacs holding spores called **Thecæ** or **Asci**. To these fungi the name **Pyrenomycetous** is given.

In other fungi, the **Discomycetes**, the stroma gives support to organs resembling the apothecia of lichens, upon which are situated asci and stylo-spores.

In **Hymenomycetes** (Mushrooms), a distinct organ, the fleshy fruit, is held upon a stalk arising from the mycelium. This is at first contained in a kind of case, termed a **Volva**, which becomes ruptured as the mushroom develops.

To the broad, flattened part the name of **Pileus** is given; on its under-surface **Lamellæ** or **Gills** are arranged.

The **Lamellæ** consist of vertical plates, which radiate from the centre to the circumference of the pileus, and collectively are called the **Hymenium**. This portion of the mushroom originally is concealed by a kind of covering, the **Indusium**, of which a part is attached permanently to the **Stipe** or stalk, and is called the **Annulus**.

From the sides of the lamellæ the spores project, called **Basidio-spores**, since they are supported on **Basidia** or little stalks.

In some mushrooms there are no gills, these being replaced by other forms of laminæ or processes.

In some, as in Peziza, the stalks give support, not to *single* basidio-spores, but to asci, or cases in which four to eight spores are contained, and thus termed **Theca-spores** or **Asco-spores**.

In the **Gasteromycetous Fungi** (Puff-balls, etc.), the **Peridium**, when young, contains a convolute lamina, upon which are developed the basidio-spores. This lamina subsequently decays, the spores being set free in the interior of the ball.

Among the Truffles, the laminæ are convoluted irregularly, but are not held in a peridium, and give origin to *asco-spores*, not *basidio-spores.*

Very little is known of the spermatia of fungi.

ALGÆ OR SEAWEEDS.

In this group are included the lowest vegetables; they are mostly marine; some occur in damp places and in fresh water; many are microscopical.

There are **Three Divisions** of Algæ, viz. :—

1. Chlorospermeæ, Confervoideæ, or Green Algæ.
2. Rhodospermeæ, Floridæ, or Red Algæ.
3. Melanospermeæ, Fucaceæ, or Olive Seaweeds.

GREEN ALGÆ.

These plants, in their simplest condition, are only simple cells having all the powers of reproduction and nutrition by division. In the Diatomaceæ the amount of siliceous matter is remarkable.

A higher condition occurs in which the cells are arranged in elongated filaments, growing either at their extremities, or by division of the cells nearer to the centre. Conjugation has been observed to take place among these. In others, **Gonidia** or Zoospores are formed; these are simply the cell contents without the coat of cellulose, and are provided with cilia.

With some there are two varieties of spores, large, **Macrogonidia**, and small, **Microgonidia.**

The latter, by some authors, are considered spermatozoids.

The Ulvæ are *broad* and long, and are usually green.

THE RED ALGÆ

Vary much as to form; some are filamentous and branched, others shrub-like; and their consistency *varies from a mem*branous state to the hardness of stone, as in the Corallines, being due to the carbonate of lime contained. They are of various colours, but never green. Their reproduction takes place by antheridia, spores, and tetraspores.

The shape of the antheridia varies; they consist of numerous cells, in each of which is contained a spermatozoid. The spores are either naked or covered by special conceptacula or sacs, called **Coccidia, Ceramidia,** and **Favellæ,** and are composed of two gelatinous coats, by which a granular mass is enclosed.

The spores originate from the cells of jointed threads.

The tetraspores are either isolated and naked, or collected into groups upon the surface of the frond, or occupy cavities termed **Stichidia** or **Conceptacula.**

The **Perispore** (the large parent cell) contains four tetraspores, supposed to be analogous to **Gonidia.**

No zoospores have been found in the Red Algæ.

THE OLIVE SEAWEEDS.

These weeds vary in general appearance from small tufted filaments to immense stalks terminated by a branched thallus.

In the higher forms, a shrubby aspect, a kind of root, and an epidermal layer are observed. Their colour is not bright green, but in general olive.

The zoospores originate in **Oosporangia,** situated at ends or joints of the frond, or in each of the cells of a filamentous body called a **Trichosporangium**; they resemble those of the Green Algæ.

The zoospores from the Trichosporangium have been mistaken for spermatozoids.

The spores reside in sacs termed **Perispores,** having a lining membrane, the **Epispore.**

The perispores or sporangia are either scattered or are arranged in **Sori** or groups on the frond's surface, or in cavities, **Scaphidia** or conceptacula, communicating by a pore with its surface.

The scaphidia may appear as club-shaped masses or receptacula at the edges of the frond.

The antheridia are ovate sacs which contain **Antherozoa** or **Phytozoa** (two ciliated spermatozoids), and appear on slender filaments in the same or other plants, and in the same or other conceptacles as the spores. If on the same plant, they are called **Monœcious**; if on different, **Diœcious.** When in the same conceptacles with the spores, they are Hermaphrodite. To the slender filaments destitute of antheridia the name of Paraphyses is given.

XIX.—THE SAP.

After the lethargy of the winter, the roots of plants, in the early spring, begin to put on renewed activity. By the action of the diastase or vegetable fibrine of the roots, the starch they contain is converted into dextrine, and subsequently into sugar. A process of endosmosis is then induced, the cell contents are increased in density, through the solubility of the sugar, and thus the soil-fluids pass into the interior of the plant. Simultaneously with the root, the upper part of the plant acquires increased activity; exhalation becomes more energetic, and in consequence of an increase in density of the cells of that part, the sap tends to pass upwards. It is probable that in the spring, when there is an abundance of sap, the ascent of this fluid may be in some measure induced by capillary attraction, since capillary vessels will always raise fluids to a certain height; and these fluids being constantly renewed by *evaporation* or other means, an upward current is a *necessary conse*quence.

The ascending sap chiefly consists of water, carbonic acid, and oxygen; but contains also various soluble matters derived from the soil.

There are several theories as to the course of the ascending and descending sap.

In **Acrogens** the course of the fibro-vascular bundles seems to be taken by the ascending sap; while in the cellular, like **Fungi**, there is no definite route. It has been held that there is no descending current of the sap after its elaboration amongst acrogens.

It would appear that in **Monocotyledons** the sap takes the course of the isolated bundles, the chief ascending channels being the elongated cells which surround the spiral vessels.

It is universally admitted that in **Dicotyledons** there is an ascending current of crude, and a descending current of elaborated sap; but by what means these processes are occasioned there is great difference of opinion. The general idea is that this fluid passes upwards through the young wood or alburnum.

In the spring, before the development of the leaves, but after absorption by the roots has commenced, every part of the stem is gorged with fluid, and in some plants, as the Vine, which are liable to *bleeding*, the vegetable sap escapes.

Upon attaining the level of the leaves, light and air exert their influence, and then begins the descent of the elaborated sap, but, in what manner, opinions are divided. It is generally agreed that the bark is the chief agent concerned in its downward transmission; but some think that the intercellular spaces and the vessels are the chief agents engaged, others holding that the principal channels are the laticiferous vessels. From the bark the medullary rays convey inwards the *elaborated juices.*

The actual cause of the descent of the sap is unknown, but in dicotyledons it is certain that it takes place.

In fruit trees a process termed "ringing" is adopted. This consists in depriving them of a circular piece of bark, which operation prohibits the descent of the sap, and is favourable to the production of fruit on the upper parts.

If a plant be made to take up a substance capable of easy recognition by some chemical reaction—such as (1) sulphate of copper, which, when liquor ammoniæ is added in excess, yields a splendid sapphire blue, or (2) ferrocyanide of potassium, which with a ferric salt forms a deep Prussian blue, we can estimate the rapidity of the ascent of the sap by taking a portion of the fluid from the trunk at different heights, and noting the time at which the first reaction occurs.

For the furtherance of the circulation of plants, heat, light, and moisture appear the most powerful auxiliaries. The force of the ascending sap is very great in some plants, and it has been found capable of sustaining a mercurial column thirty-eight inches in height.

XX.—CHEMICAL CONSTITUTION OF PLANTS.

The chemical constituents of plants are

(1) **Inorganic** and (2) **Organic.**

The **Inorganic** constituents of plants are:—

1. **Phosphorus,** as phosphoric acid in the form of phosphates.
2. **Sulphur,** as sulphuric acid in sulphates and otherwise combined.
3. ***Potassium,*** as potash combined with acids.
4. ***Sodium,*** as soda combined with acids.

5. **Silicon**, as silica forming silicates.
6. **Calcium**, as the oxide (Lime) combined with acids.
7. **Magnesium**, as magnesia combined with acids (rare).
8. **Chlorine**, in metallic combination, as chloride.
9. **Iodine**, in metallic combination, as iodide.
10. **Ferrum** (Iron), as the persalt (rare).
11. **Manganese**, as the persalt (very rare).
12. **Bromine**, combined as bromide.
13. **Fluorine**, combined as fluoride (very rare).
14. **Aluminium**, very rare as alum (very rare).

The same chemical compounds do not exist in all plants, and the same plant, when grown in different localities, does not yield ashes having the same composition.

Silica exists in large quantities in the stems of grasses, whereas it is very scanty in the leguminous plants.

The phosphates are present chiefly in seeds, and they may be almost absent in the stems of the same plants.

Lime is abundant in leguminous stems, in grasses it is very scanty, and more of this substance is present in the bark than in the wood of trees, in which situation it is replaced by potash and soda, especially the former.

Plants which, as a rule, contain soda when grown by the sea, may yield potash if grown inland.

In most plants lime abounds; in the cereal seeds it occurs as the phosphate; in the Characeæ it is found as carbonate and sulphate, and in some plants it appears as oxalate under the form of raphides.

Silica chiefly occurs in grasses, the Diatomaceæ and *Equisetaceæ*.

Iodine is found only in marine plants.

The **Organic** constituents of plants are :—

Carbon, Oxygen, Hydrogen, and sometimes **Nitrogen** united in different proportions ; and the compounds are divided into **Azotised** or **Nitrogenous,** and **Non-Azotised** or **Non-Nitrogenous.**

Carbon is by far the most common constituent, and is abstracted by plants from the atmosphere, in which it exists combined with oxygen, as carbonic anhydride (CO_2). When wood burns or decays, the carbon is converted into carbonic anhydride.

Vegetable Mould is produced by the decay of plants; this cannot be absorbed, but provides a medium for abstracting from the air substances, which subsequently may be absorbed by the plants.

Oxygen exists in large quantity, and is chiefly found as water (H_2O) and carbonic anhydride (CO_2).

Hydrogen occurs chiefly as water, but is also found combined with carbon in fats, oils, resins, etc.

The **Nitrogenous** or **Azotised** substances usually contain, in addition, Sulphur and Phosphorus. Albumen is the type of this class. Next in importance is vegetable fibrine (observed in the gluten of wheat) and vegetable casein (in the legumen of pulse).

Ammonia (NH_3) is supposed to supply plants with nitrogen ; but the nitrates of the soil are also considered to yield this element.

The nitrogenised substances abound more in the seed than in other parts of the plant, and in the external rather than the interior of the seed ; thus, less flesh-forming material resides in the pure white bread (chiefly composed of starch) than in the brown bread, or bread which contains the outer part of the grain of wheat.

Soils.—The most abundant constituents of soils are **Sand** or **Silica, Clay** or **Aluminium Silicate, Lime, Potash,** and **Vegetable Mould.** A *loamy* soil contains the foregoing in varying proportions.

If one kind of crop is repeatedly grown on a soil, no matter how fertile, it must eventually abstract the whole of the available matter from the soil which is thus left barren, but only with reference to this crop; for if any other sort of crop be substituted, its growth may be just as strong, and its produce quite as satisfactory. Upon this fact is founded the so-called *Rotation* of crops.

Silica is chiefly abstracted by cereals; lime, by beans and clover; potash, by turnips and potatoes. To supply the deficiency of soil-salts special manures are employed, the most important ingredients of which are ammonia and phosphates.

XXI.—PHYSIOLOGY OF THE FLORAL ENVELOPES.

The green parts of a flower exercise the same function as the leaves, and in addition protect the delicate organs which are internal to them. These parts, after absorbing carbonic anhydride, evolve oxygen; but the coloured parts absorb oxygen, and give out carbonic anhydride. In this way the starch, which is frequently present in the receptacle, becomes oxidised and transformed into sugar, thus providing nourishment for the essential organs.

Heat-Evolution.—In consequence of this oxidation, heat is evolved by flowers, but the process being gradual, and the exposed surface large, it passes imperceptibly into the atmosphere around.

If the heat is confined, as in the spathæ of the

Araceæ, the temperature has been found to rise from 15° to 50° Fahr. higher than that of the air by which the plant is surrounded.

If a plant be placed in oxygen gas, the heat is increased.

Age of producing Flowers.—Some plants rise from the seed, produce flowers, and in a single season die; they are then called **Annuals** (⊙).

Others increase in size only during the first year, produce flowers, and decaying during the second year, are termed **Biennials** (♂).

A third kind continues to produce flowers for several successive years, in which case they are called **Perennials** (♃).

Some plants do not produce flowers until after many years, and die immediately after the maturing of the fruit, as if exhausted by the process.

Since different flowers appear at different seasons of the year, and expand with tolerable regularity, a sort of "Floral Calendar" is formed.

In flowers which close during the night, there are variations with regard to the time of the day when they expand again. Some open in the early morning, some at midday, and some in the evening.

A remarkable tendency to shut and open is observed in the Compositæ. Some plants remain closed during the day, and only open at night.

It is stated that the cause of these movements is heat, and that they are influenced by light only so far as it is generally accompanied by a certain amount of heat.

Colour of Flowers.—The corolla is the part most often coloured, but the calyx and bracts are so occa*sionally.* Flower-colour is exceedingly variable, and *as a specific* character is of little use, except among *lower plants,* as Algæ and Fungi.

Cultivation exerts a powerful effect in the modification of the colours of flowers; but all the changes are controlled within certain definite limits.

Two series of colours are recognised:

1. A **Xanthic** or **Yellow**, and 2. A **Cyanic** or **Blue**.

These imperceptibly merge into one another, but if a plant belongs to one series, as the blue, it can never be made to turn yellow, and *vice versâ*.

Odour of Flowers.—Flowers usually owe their smell to some volatile oil or resin; the odour is generally given out on exposure to sunlight, though sometimes only during the night. The least showy flowers are often the most aromatic, and those of a brown or orange tint usually possess a fetid odour.

OFFICINAL SEEDS.

Amygdalus Communis. Almond.
Cardamomum. Elettaria Cardamomum. Cardamom.
Colchicum Autumnale. Meadow Saffron.
Croton Tiglium. Croton.
Ergota. Secale Cornutum. Ergot.
Gossypium Herbaceum. Cotton.
Hordeum Distichon. Pearl Barley.
Linum Usitatissimum. Linseed or Flax.
Myristica Officinalis. Nutmeg.
Nux Vomica. Strychnos Nux Vomica.
Ricinus Communis. Castor Oil Plant.
Sinapis Alba et Nigra. White and Black Mustard.
Stramonium. Datura Stramonium. Thorn Apple.
Triticum Vulgare. Wheat.

NATURAL ORDERS.

Exogen.

Thalamifloræ.
- Ranunculaceæ.
- Papaveraceæ.
- Cruciferæ.
- Rutaceæ.

Calycifloræ.
- Leguminosæ.
- Rosaceæ.
- Cucurbitaceæ.
- Umbelliferæ.

Corollifloræ.
- Compositæ.
- Gentianaceæ.
- Convolvulaceæ.
- Solanaceæ (Atropaceæ).
- Scrophulariaceæ.
- Labiatæ.

Endogenæ.

Petaloideæ.
- Liliaceæ.
- Melanthaccæ.

Glumiferæ. Graminaceæ.

Acrogenæ.

Filices.

1. RANUNCULACEÆ.—Crowfoot Family.

Exogenæ, Thalamifloræ, Dicotyledones.

Sepals, five or more, rarely fewer,
often petaloid, deciduous or seldom persistent, imbricate or valvate in bud.

Petals, five, four, two, or none, often undeveloped.

Stamens, indefinite, hypogynous, adnate.

Pistils, definite or indefinite.

Fruit, apocarpous, consisting of one-seeded achenes or many-seeded follicles.

Seeds, solitary and albuminous.

Characters: Herbs, perennial or annual, very rarely shrubs, having a watery acrid juice.
No distinct stipules; æstivation imbricate;

Distribution: a large order, distributed all over the world.

Properties: acrid, and some highly poisonous.

For study: Common Buttercup.

OFFICINAL PLANTS.

1. **Aconitum Napellus.** Monkshood. (Fresh leaves and flowering tops, dried root and alkaloid Aconitia.)
2. **Podophyllum Peltatum.** American May Apple. (Dried rhizome and resin Podophyllin.)

2. PAPAVERACEÆ.—Poppy Family.

Exogenæ, Thalamifloræ, Dicotyledones.

Sepals, two, rarely three, caducous.

Petals, four, equal, free, often crumpled in æstivation.

Stamens, indefinite and hypogynous.

Pistil, solitary.

Fruit, syncarpous (capsules).

Seeds, indefinite and enveloped in oily albumen.

Leaves, alternate, entire, lobed or finely divided, without stipules.

Ovary, one-celled, with parietal placentæ.

Characters: Herbs, annual or perennial, with a milky juice.

Distribution: principally European.

Properties: narcotic.

For Study: Red Poppy.

OFFICINAL PLANTS.

1. **Papaver Rhœas.** Red Poppy. (Fresh petals.)
2. **Papaver Somniferum.** White Garden or Opium Poppy. (Sliced unripe dried capsule, yielding opium.)

3. CRUCIFERÆ.—Cabbage Family.

Exogenæ, Thalamifloræ, Dicotyledones.

Sepals, four, free (of which two are often saccate at the base), deciduous.

Petals, four, cruciform, deciduous.

Stamens, six, tetradynamous and hypogynous.

Fruit, a silique or silicula.

Flowers, in corymbs, often becoming racemes and without bracts.

Ovary, two-celled, of two connate carpels, with parietal placentæ.

Seeds, without albumen.

Characters: Herbs, rarely shrubby plants; leaves alternate, without stipules.

Distribution: temperate climates.

Properties: always wholesome, many of the plants affording vegetable food, as cabbages, radishes, turnips, watercress, and some used as condiments possessing a volatile oil, in which sulphur and nitrogen are present.

For Study: Garden Wallflower.

OFFICINAL PLANTS.

1. **Cochlearia Armoracia.** Horse-radish. (Fresh root.)
2. **Sinapis Alba and Nigra.** White and Black Mustard. (Seeds.)

4. RUTACEÆ.—Rue Family.

Exogenæ, Thalamifloræ, Dicotyledones.

Sepals, three to five.
Stamens, definite and hypogynous.
Pistil, one.
Ovary, two to five-celled.
Leaves, exstipulate and dotted with oil glands.
Characters : Herbs, shrubs, or trees.
Distribution : temperate climates.
Properties : various.
For Study : Common Rue.

OFFICINAL PLANTS.

1. **Barosma** Betulina, Crenulata, Serratifolia. Buchu. (Dried leaves.)
2. **Galipea Cusparia.** Angustura Bark Tree. (Bark.)
3. **Ruta Graveolens.** Rue. (Oil from fresh leaves and unripe fruit.)

5. LEGUMINOSÆ.—Pea Family.

Exogenæ, Calycifloræ, Dicotyledones.

Sepals, five.

Petals, five.

Stamens, perigynous.

Pistil, simple.

Fruit, a legume.

Characters: Herbs, shrubs, and trees; leaves alternate, stipulate, frequently compound; seeds without albumen.

Three Sub-orders.

1. **Papilionaceæ.** Papilionaceous flowers, the odd petal or vexillum external in imbricate æstivation, stamens ten (nine united and one free).
2. **Cæsalpineæ.** Regular flowers, the odd petal internal, corolla imbricated, stamens ten, free and adherent to calyx.
3. **Mimoseæ.** Regular flowers, corolla valvate in æstivation, stamens indefinite.

Distribution: universal.

Properties: very various, the majority not poisonous.

Among the poisonous plants are Laburnum, Physostigma venenosum, Erythrophlœum guinense, Indigo, roots of Phaseolus multiflorus and Phaseolus radiatus, and seeds of Lathyrus aphaca.

For Study: Garden Pea.

OFFICINAL PLANTS.

Papilionaceæ.

1. Astragalus verus. Tragacanth. (Gummy exudation.)
2. Glycyrrhiza glabra. Liquorice. (Root.)
3. Myroxylon Pereiræ. Balsam of Peru. (Balsam.)
4. Myroxylon Toluifera. Tolu balsam. (Balsam.)
5. Physostigma venenosum. Calabar Bean. (Bean.)
6. Pterocarpus marsupium. Kino. (Inspissated juice hardened in the air.)
7. Pterocarpus santalinus. Sandal. (Wood.)
8. Sarothamnus scoparius. Broom. (Flowering tops.)

Cæsalpineæ.

1. Cassia fistula. Purging cassia. (Pulp.)
2. Copaifera multijuga. Copaiba. (Oleo-resin.)
3. Hæmatoxylum campechianum. Logwood. (Wood.)
4. Senna { Alexandrina / Indica }. (Leaves.)
5. Tamarindus indica. Tamarind. (Pulp.)

Mimoseæ.

Acacia. Gum Arabic. (Gummy exudate.)

6. ROSACEÆ.—Rose Family.

Exogenæ, Calyciforæ, Dicotyledones.

Sepals, five.

Petals, five.

Stamens, indefinite, perigynous or epigynous.

Pistil, very various.

Ovaries, one or numerous, free or coherent.

Ovules, one, two, five, or numerous, without albumen.

Characters: Herbs, shrubs, or trees. Leaves alternate. Flowers regular. Divided by the fruit into

Three Sub-orders.

1. **Roseæ.** Fruit apocarpous, stipules adnate, style lateral.

   Fruit an **hetærio**, or consisting of follicles; seed usually suspended. (Dog Rose.)
2. **Pomeæ.** Ovary inferior, five-celled, styles terminal, stipules free, seeds ascending.
   Fruit a **pome**. (Apple.)
3. **Amygdaleæ.** Trees or shrubs. Ovary superior, stipules free, styles terminal, seed ascending.

   Fruit a **drupe**. (Cherry.)

Distribution: universal.

Properties: various, none poisonous, except the bitter almond and cherry laurel.

For Study: Dog Rose, Apple and Cherry.

OFFICINAL PLANTS.

1. **Amygdalus Communis.** Almond Tree. (Seed.)
   - Amygdala Amara. Bitter Almond.
   - Amygdala Dulcis. Sweet Almond.
2. **Brayer Anthelmintica.** Cusso. (Flowers and tops.)
3. **Prunus Domestica.** Plum. (Dried drupe.)
4. **Prunus Laurocerasus.** Cherry Laurel. (Fresh leaves.)
5. **Rosa Canina.** Hips. (Ripe fruit.)
6. **Rosa Centifolia.** Cabbage Rose. (Fresh petals.)
7. **Rosa Gallica.** Red Rose. (Fresh and dried unexpanded petals.)

7. CUCURBITACEÆ.—Gourd Family.

Exogenæ, Calycifloræ, Dicotyledones.

Flowers, unisexual; *i.e.*, male and female flowers separate.

Fruit, a pepo, usually indehiscent, with three carpels and parietal placenta.

Male flowers have:—

Sepals, five.

Petals, five.

Stamens, three, either distinct or coherent.

Female flowers have:—

Sepals, five.

Petals, five.

Pistils, three.

Seeds, exalbuminous.

Characters: Trailing hairy plants, herbaceous, usually succulent, spreading by cirrhi or tendrils;

Calyx-tube adherent to **ovary**, which is inferior.

Ovary, usually of three to five carpels, coherent, placentæ fleshy.

Distribution: chiefly warm climates.

Properties: as a rule purgative.

For Study: Common Cucumber.

OFFICINAL PLANTS.

1. **Citrullus Colocynthis.** Colocynth. (Dried decorticated fruit freed from the seeds.)
2. **Ecbalium Officinarum.** Squirting Cucumber. (Nearly ripe fruit.)

   Elaterium, a sediment of the juice of the above.

8. UMBELLIFERÆ.—Parsley Family.

Exogenæ Calycifloræ, Dicotyledones.

Sepals, five, very small.

Petals, five, valvate or subimbricate in bud, inserted outside an epigynous disc, free, caducous, and generally inflexed at the point.

Stamens, five, alternate with the petals, epigynous.

Fruit, a cremocarp, separating when mature into two mesocarps, supported by a gynophore and marked by vittæ.

Flowers, in umbels and umbellules.

Ovary, two-celled.

Calyx, superior.

Seeds, solitary, pendulous, and albuminous.

Characters: Herbs, stems generally hollow, leaves alternate, and sheathing the stems.

Distribution: temperate zone.

Properties: various, some very poisonous.

OFFICINAL PLANTS.

1. **Anethum Graveolens.** Dill. (Fruit and oil.)
2. **Carum Carui.** Caraway. (Fruit and oil.)
3. **Conium Maculatum.** Hemlock. (Leaves and fruit.)
4. **Coriandrum Sativum.** Coriander. (Fruit and oil.)
5. **Dorema Ammoniacum.** (Gum resin.)
6. **Euryangium Sumbul.** Musk-root. (Root.)
7. **Fœniculum Dulce.** Sweet Fennel. (Fruit.)
8. **Galbanum Officinale.** (Gum resin.)
9. **Narthex Assafœtida.** (Gum resin.)
10. **Pimpinella Anisum.** Anise. (Oil.)

9. COMPOSITÆ.—Composite Family.

Exogenæ, Corollifloræ, Dicotyledones.

Sepals, reduced to a few hairs.

Petals, united, monopetalous; corolla tubular, labiate or ligulate.

Stamens, five, epipetalous, inserted on corolla, and syngenesious, anthers cohering into a tube which sheathes the style.

Flowers, in heads (capitula) surrounded by an **involucrum of bracts** (phyllaries), each floret being encircled by a secondary involucel of paleæ.

Ovary, inferior, one-celled, one-seeded.

Ovule, erect.

Fruit, dry, indehiscent.

Seeds, exalbuminous.

Characters: Herbs or shrubs.

For Study: Daisy, Dandelion.

Three Sub-orders.

1. **Tubulifloræ**. Corolla tubular, regularly four five-lobed, either in all the flowers (when the head is discoid), or in central ones only, the marginal flowers presenting a ligulate corolla.
2. **Labiatifloræ**. Corolla, of the disc-flowers, bilabiate; florets perfect unisexual or neuter.
3. **Ligulifloræ**. Corolla of the flowers (both disc and ray) ligulate (strap-shaped) and perfect.

Distribution: universal.

Properties: chiefly bitter.

For Study: Daisy, Dandelion.

OFFICINAL PLANTS.

1. **Anacyclus Pyrethrum.** Pellitory. (Root.)
2. **Anthemis Nobilis.** Chamomile. (Flowers and oil.)
3. **Arnica Montana.** (Rhizome and rootlets.)
4. **Artemisia Santonica.** (Flower-heads unexpanded.)
5. **Lactuca Virosa.** Lettuce. (Flowering plant.)
6. **Taraxacum Dens Leonis.** Dandelion. (Root.)

10. GENTIANACEÆ.—Gentian Family.

Exogenæ, Corollifloræ, Dicotyledones.

Sepals, five.

Petals, united, monopetalous; corolla with five segments.

Stamens inserted upon the corolla, equal in number to the segments.

Corolla, convolute and withering.

Calyx, persistent.

Ovary, one-celled, with two parietal placentæ; many-seeded and albuminous.

Characters: Herbs with a bitter juice; leaves exstipulate, flowers regular.

Distribution: general.

Properties: tonic and bitter.

For Study: Gentianella and other garden gentians.

OFFICINAL PLANTS.

1. **Gentiana Lutea.** Gentian. (Dried root.)
2. **Ophelia Chirata.** Chiretta. (Entire plant.)

11. CONVOLVULACEÆ.—Bindweed Family.

Exogenæ, Corollifloræ, Dicotyledones.

Sepals, five.

Petals, monopetalous; corolla in five segments, campanulate or funnel-shaped, deciduous.

Stamens, five, inserted into base of corolla.

Ovary, two or four-celled, each cell containing two seeds, albuminous, and ovule erect.

Characters: Herbs, often twining, and containing a milky juice; leaves alternate, calyx imbricate, cotyledons foliaceous.

Distribution: general.

Properties: purgative.

For Study: Wild or Garden Convolvulus.

OFFICINAL PLANTS.

1. **Convolvulus Scammonia.** Scammony. (Root and resin.)
2. **Exogonium Purga.** Jalap. (Dried tubercles and resin.)

12. SOLANACEÆ ATROPACEÆ.—Nightshade Family.

Exogenæ, Corolliflora, Dicotyledones.

Sepals, five.

Petals, united, monopetalous; corolla five-partite, usually regular.

Stamens, five; epipetalous, and equal to the lobes of the corolla.

Pistil, one.

Æstivation, valvate or induplicate valvate; anthers introrse.

Dehiscence, porous or longitudinal.

Fruit, a berry or capsule.

Ovary, superior, usually two-celled.

Seeds, numerous and albuminous.

Characters: Herbs or shrubs, with a watery juice, leaves alternate, embryo straight or curved.

Distribution: universal.

Properties: sedative and narcotic, acrid, divided into the (*a*) Non-Poisonous or Solanaceæ Proper and the (*b*) Poisonous or Atropaceæ. The Atropaceæ is one of the most deadly orders known.

For Study: The woody Nightshade and deadly Nightshade.

OFFICINAL PLANTS.

Solanaceæ.

1. **Capsicum Fastigiatum.** Chillies. (Dried fruit.)
2. **Solanum Dulcamara.** Woody Nightshade. (Dried young branches.)

Atropaceæ.

1. **Atropa Belladonna.** Deadly Nightshade. (Leaves, root, and alkaloid Atropia.)
2. **Datura Stramonium.** Thorn Apple. (Leaves and seeds.)
3. **Hyoscyamus Niger.** Henbane. (Whole plant.)
4. ***Nicotiana* Tabacum.** Tobacco. (Leaves.)

13. SCROPHULARIACEÆ.—Figwort Family.

Exogenæ, Corollifloræ, Dicotyledones.

Sepals, four or five, cohering.

Petals, monopetalous; corolla five-partite and irregular, usually bilabiate.

Stamens, four, didynamous, or two, or rarely five (one sometimes sterile), inserted upon the corolla tube.

Pistil, one, carpels two, cohering.

Ovary, superior, two-celled and many-seeded, placenta axile.

Seeds, albuminous.

Characters : Herbs or shrubby plants, leaves usually exstipulate, and alternate. Flowers, more or less irregular. Inflorescence various.

For Study : Foxglove.

OFFICINAL PLANT.

Digitalis Purpurea. Purple Foxglove. (Leaves and active principle.)

14. LABIATÆ.—Mint Family.

Exogenæ, Corolliflor æ, Dicotyledones.

Sepals, five.

Petals, united, monopetalous; corolla five-partite, irregular, and lipped.

Stamens, four (didynamous) or two.

Pistil, one.

Ovary, superior, four-cleft, each carpel containing a single ovule.

Fruit, four small nuts.

Flowers, irregular, labiate.

Seeds, erect, with slight albumen.

Characters: aromatic herbs, always having square stems, with opposite leaves; calyx persistent.

Distribution: temperate climates.

Properties: aromatic, none poisonous, and all containing a volatile oil.

For Study: White Dead Nettle.

OFFICINAL PLANTS.

1. **Lavandula Vera.** Lavender. (Oil.)
2. **Mentha Piperita.** Peppermint. (Oil.)
3. **Mentha Viridis.** Spearmint. (Oil.)
4. **Rosmarinus Officinalis.** Rosemary. (Oil.)

15. LILIACEÆ.—Lily Family.

Endogenæ, Petaloideæ, Monocotyledones.

Sepals, three, petaloid, } constituting a perianth.
Petals, three, }
Stamens, six.
Anthers introrse, *i.e.*, turned inwards.
Pistil, one.
Ovary, superior, three-celled.
Flowers, regular and perfect.
Fruit, usually capsular.
Perianth, six-partite.
Seeds, albuminous.
Characters : Herbs.
Distribution : universal.
Properties : various, none poisonous.
For Study : Tulip, White Lily.

OFFICINAL PLANTS.

1. **Urginea Scilla.** Squill. (Sliced bulb.)
2. **Aloe** { **Barbadensis** / **Socotrina** }. (Inspissated juice.)

16. MELANTHACEÆ.—Colchicum Family.

Endogenæ, Petaloideæ, Monocotyledones.

Flowers, regular, three-partite.
Perianth, free.
Stamens, six.
Anthers extrorse, *i.e.*, turned outwards.
Pistil, one; **styles**, three.
Fruit, three-celled.
Seeds, albuminous.
Characters: Herbs with corms, bulbs or swollen roots.
Distribution: general.
Properties: very dangerous.
For Study: Autumn Crocus.

OFFICINAL PLANTS.

1. **Asagræa Officinalis.** Sabadilla. (The source of the alkaloid Veratria.)
2. **Colchicum Autumnale.** Colchicum. (Corm and seed.)
3. **Veratrum Viride.** Green Hellebore. (Root.)

17. GRAMINACEÆ.—Grass Family.

Endogenæ, Glumiferæ, Monocotyledones.

Flowers, composed of a whorl of bracts termed **glumæ**.

Calyx, of scales termed **paleæ**.

Corolla, two or three scales termed **squamæ** or **lodiculæ**, sometimes wanting.

Stamens, three, rarely two, hypogynous.

Anthers, versatile.

Styles, two.

Ovary, superior, one-celled.

Ovule, solitary.

Fruit, a caryopsis.

Seeds, albuminous.

Characters: usually herbs; stem round, jointed, and generally hollow; leaves alternate; sheath of the leaves split.

Distribution: universal.

Properties: various.

For Study: Wheat.

OFFICINAL PLANTS.

1. **Hordeum Distichon.** Pearl Barley. (The husked seed.)
2. **Saccharum Officinarum.** Refined Sugar.
3. **Secale Cereale**
   Secale Cornutum (Ergot) (The sclerotium or spawn of a fungus, the Claviceps purpurea.)
4. **Theriaca.** Treacle. (Uncrystallised residue of the refining of sugar.)
5. **Triticum Vulgare.** Wheaten Flour. (Flour of the seed.)
   Amylum. Starch (from the same.)

18. FILICES. FERNS.*

Acrogenæ.

Plants of this order have no flowers, and their reproductive bodies consist of simple cells without an embryo. They are divided into Acrogenæ and Thallogenæ. To the former belong the ferns. These usually have their Fronds or leaves greatly developed, and their stems only slightly so, and usually remain underground (except in the arborescent ferns), as rhizomes. The Venation of the leaves is Forked, and upon the lower surface of them are found the Sporangia or little membranous sacs containing the spores. Sometimes these sporangia are collected into groups called Sori, which are either Naked or covered by an Indusium (a membranous envelope). The spores are similar to pollen grains.

Distribution: universal.

Properties: unimportant, except the following

OFFICINAL PLANT.

1. **Aspidium Filix Mas.** Male Fern. (Dried rhizome with bases of footstalks and portions of root-fibres.)

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* See also page 49.

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